MACHINE DESIGN

THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

Volume 11 — JUNE 1939 — Number 6

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MACHINE DESIGN is published on the seventh of each month. Subscription rates: United States and possessions, Canada, Cuba and Mexico, two years $5; one year $3. Single copies 35 cents. Great Britain and other European countries, one year $5.

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Acceptance under act of June 5, 1934, authorized July 20, 1934.

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BECAUSE wherever wheels or shafts turn in modern machinery, anti-friction bearings do these 10 things:

1. Reduce friction . . . . . .

2. Reduce wear . . . . . .

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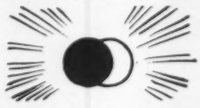
7. Permit high speed operation . .

8. Simplify design . . . . . .

9. Allow accurate inter-changeability.



10. Give assured performance . . .

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CLASSIFIED FOR CONVENIENCE WHEN STUDYING SPECIFIC DESIGN PROBLEMS

.: EDIT., EDITORIAL PAGES; ADV., ADVERTISING PAGES; R, RIGHT-HAND COLUMN; L, LEFT-HAND COLUMN

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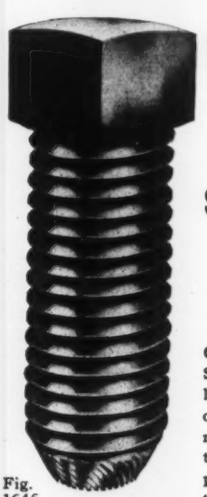

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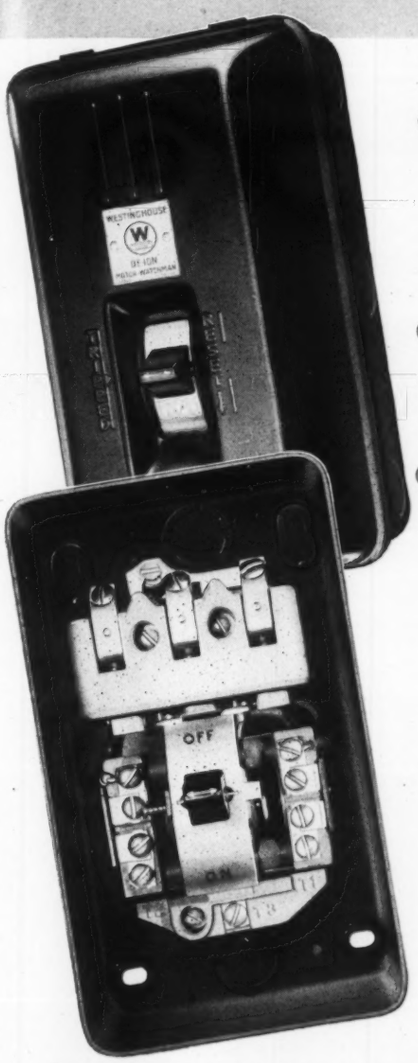

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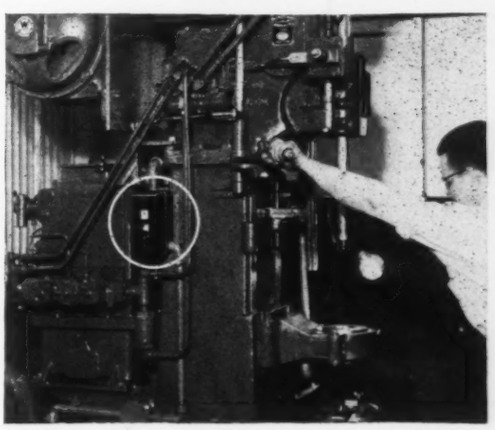

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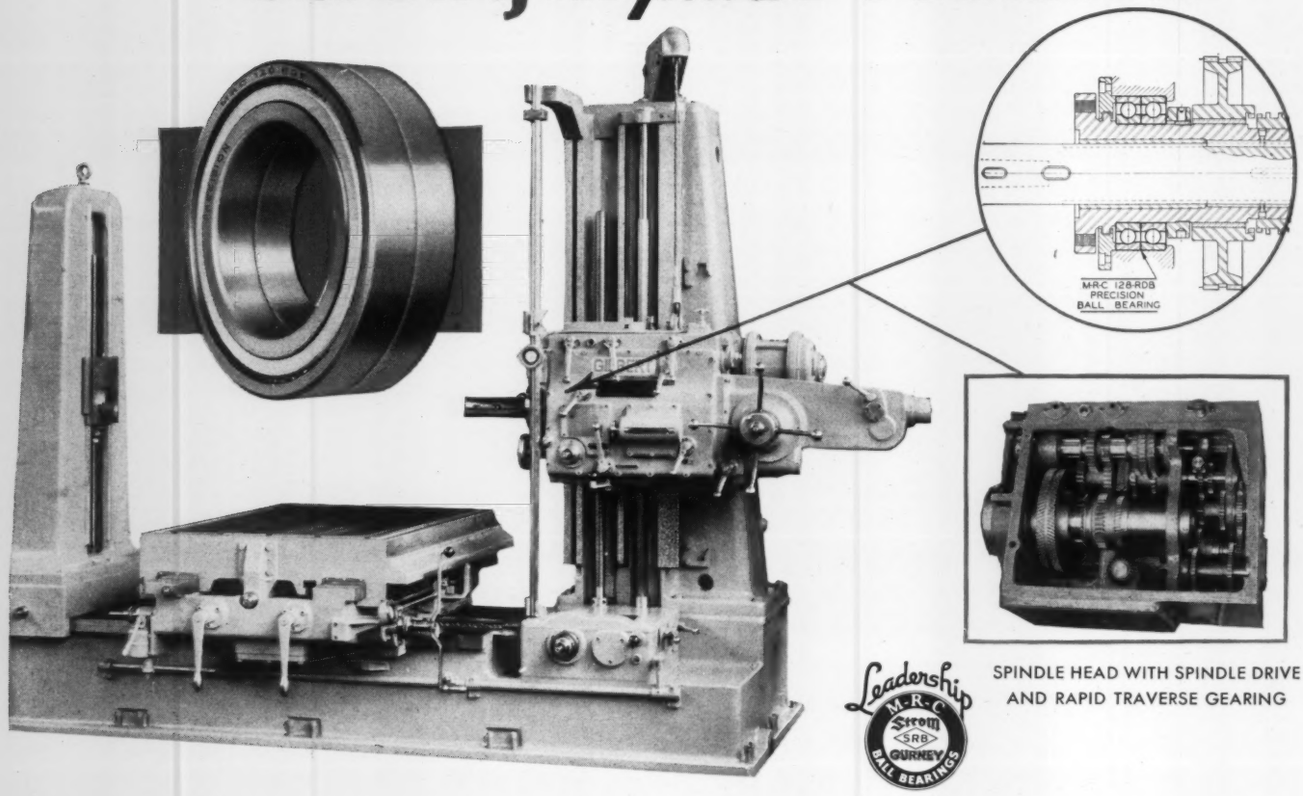

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3

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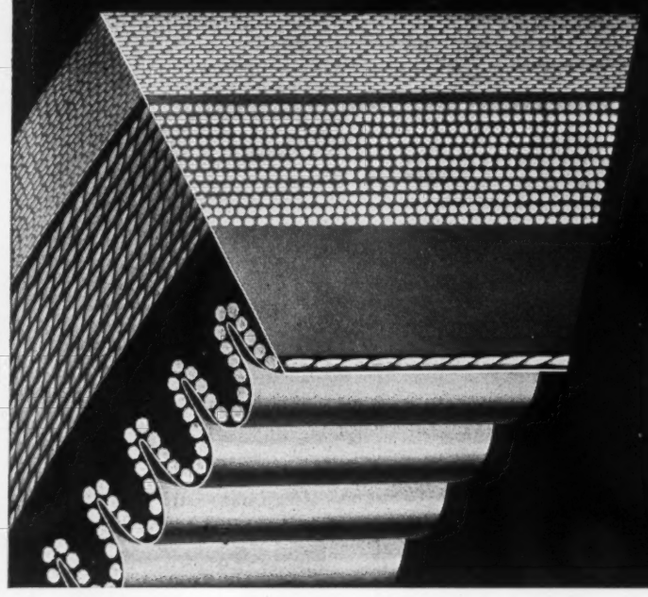

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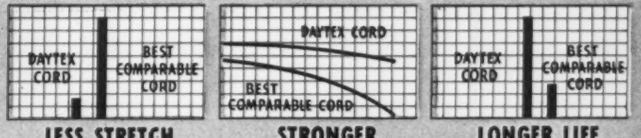

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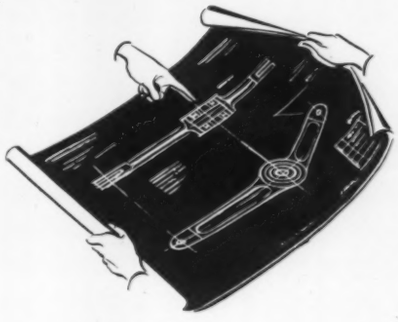

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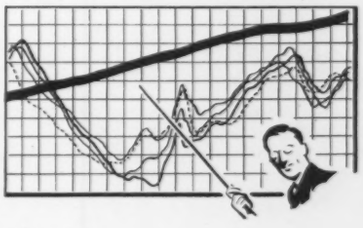

Fafnir's diversified customer-list is your soundest assurance that neither a recession or a sudden boom in any industry will affect this company's ability to serve you promptly and dependably.

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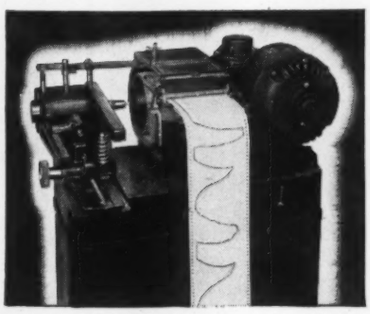

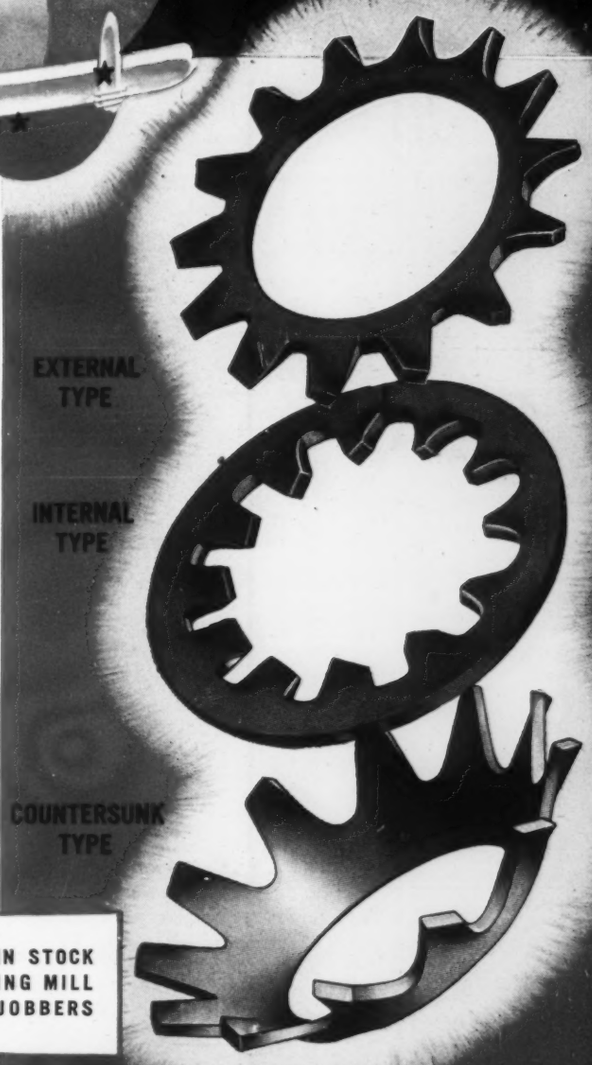

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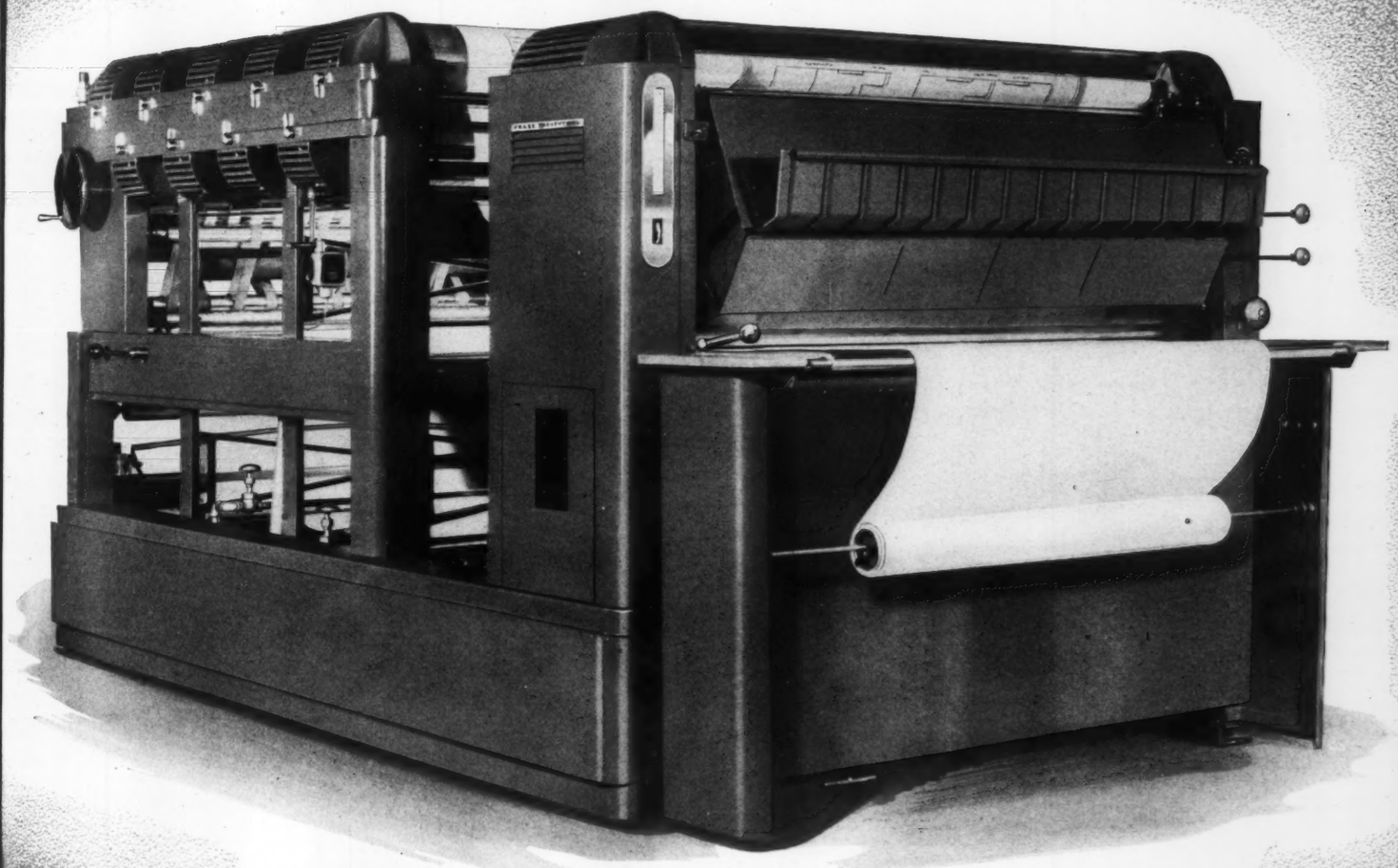

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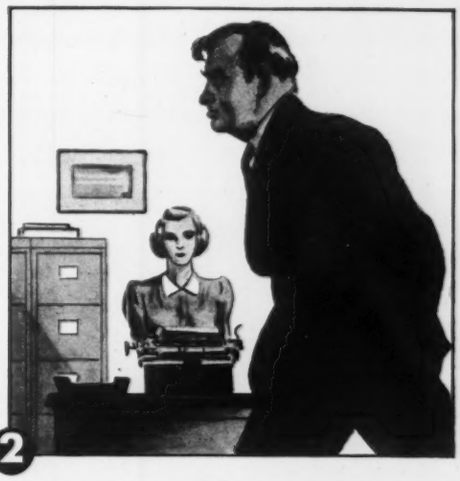
A true story of G-E service

It was stuck again! Our big annual sale was starting, and the timing device on that new safe had our money all locked up. "A department-store sale and no change!" I groaned.



"Miss Jones," I snapped, "this is the last straw! Wire the Protector* Safe Company that the sooner they get their safe out of here, the better. I wouldn't pay a dime for it!"

In a couple of hours a fellow walked in to see about the safe. "I'm from the G-E service shop here," he says. "Protector wired us you're having trouble with a timer that uses G-E equipment."

"Mind if I make some tests?" he asks. A few tests and he had the answer. Nothing wrong with the timer. Trouble came from fluctuating voltage.

"O.K. that safe bill for payment, Miss Jones," I smiled next morning. All we had to do was change the circuits the timer was connected to. Now the safe works like a charm.

IF you sell your machines throughout the United States, remember this story when you select the electric equipment for them. When your machines are G-E equipped, our entire service staff is ready to stand back of the electric part of them. No matter where you ship them, they are never outside the friendly circle of G-E service formed by our 25 service shops, our 28 warehouses, and our sales engineers in 103 cities, as shown on the map at the left.

Are you *now* in need of any information on electric equipment? Could we help your engineers with an electrical-design problem? Just get in touch with the nearest G-E sales office, or write General Electric Company, Schenectady, N. Y.

*PROTECTOR is not the safe manufacturer's real name, of course.

NEW YORK WORLD'S FAIR—SEE THE G-E "HOUSE OF MAGIC"—SAN FRANCISCO EXPOSITION

GENERAL ELECTRIC

011-502

Left—G-E 7 1/2-hp, 284-frame, standard induction motor.
Length—22 5/8 inches
Height—14 inches
Width—14 inches

Right—G-E 7 1/2-hp, 284-frame, single-reduction gear-motor.
Length—25 11/16 inches
Height—14 inches
Width—14 inches

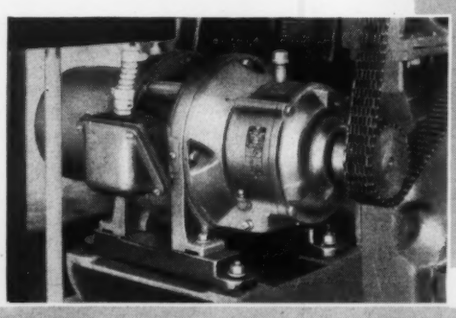
G-E GEAR-MOTORS SAVE SPACE ON LOW-SPEED APPLICATIONS

THE use of G-E gear-motors to drive low-speed equipment, such as machine tools, conveyors, pumps, agitators, mixers, and other low-speed machinery, has enabled many companies to simplify design, save valuable space, and thereby obtain greater, more efficient production.

The G-E gear-motor consists of a highly efficient planetary gear-reduction unit built into the drive end of a standard, normal-speed motor. It combines the desirable features of a normal-speed motor with those of a simple, efficient, compact reduction gear to give practically any desired low speed.

You will find it easy to select the right gear-motor for your low-speed drive problems from our complete line—1/8- to 75-hp, 6- to 600-rpm, available in many types of mechanical and electrical modifications.

It will be well worth your while to investigate the many advantages obtainable by the use of G-E gear-motors for your low-speed drives. For further information, call our nearest representative or write General Electric, Schenectady, N. Y.



Simplification of design was achieved on this machine by this totally enclosed gear-motor

Features of G-E Gear-motors

1. Standard ball-bearing motor—polyphase, single-phase, or direct-current—held in concentric alignment with gears by rabbet-fit assembly of gear casing on motor frame.

2. Helical-cut planet gears mesh with internal ring gear with the minimum of sliding or friction contact.

3. Motor shaft supported by its own bearings, independent of the gear assembly.

4. Planet cage is supported by its own bearings, widely spaced to give positive alignment and to provide for overhung loads.

5. Low-speed shaft of ample proportions—a steel forging integral with the head of the planet cage.

6. Center driving pinion integral with the motor shaft. All gears are of the helical type in order to provide continuous tooth contact. This contributes to high efficiency, long life, and smooth operation.

7. Oil-return groove adds to the effectiveness of the oil-circulation system.

8. Large oil well, provided with oil filler on top and a drain plug, affords ample splash lubrication.

GENERAL ELECTRIC

020-390

Dependable Timing

ASSURED BY 3 SIMPLE ELEMENTS

The new CR7504-A1A vacuum-tube time-delay relay for automatic timing

THREE ELEMENTS—a capacitor, a resistor, and a vacuum-tube—perform the timing function in this new timer. None of them contain moving parts to wear and require adjustment. The only moving part in the timer is the contact of a small relay.

This timer has had a remarkably quick acceptance. Already it is standard equipment on dozens of machines, among which are: (1) an automatic high-speed radius grinder; (2) a lapping grinder; (3) a plastics-molding machine; (4) an automatic trimmer; (5) a welding machine.

Its features are numerous. Time adjustment is made by a convenient knob in the cover. The use of an electronic circuit means that noise during timing is eliminated. Here are some other characteristics of the relay:

Range of Adjustment—5% to 100% Maximum timing	
Six Forms—Maximum time of 120, 60, 12, 3, and 0.9 seconds at 115 volts (20% higher at 230 volts)	
Contact Rating	Normal— 1 amp at 115 volts—0.5 amp at 230 volts
	Special—10 amp at 115 volts— 5 amp at 230 volts

Dept. 6A-201, General Electric, Schenectady, N. Y.

Please send me the following data on your vacuum-tube time-delay relay:

1. *Publication GEA-2902A, describing and illustrating it.*
2. *Sketch GES-2227, showing how one user applied the timer to control the grinder.*

Name.....

Firm.....

Address.....

080-176

GENERAL ELECTRIC

Do you use motor parts in devices like these?

Single-phase-motor parts for built-in applications

- CLAMPING DEVICES
- COOLANT PUMPS
- DRILL PRESSES
- FLOOR MACHINES
- PAINT SPRAYS
- REFRIGERATORS
- SCREW DRIVERS
- TABLE-FEED MACHINES
- TAPPING MACHINES
- TEXTILE MACHINERY
- WOODWORKING MACHINES
- AND OTHER APPLICATIONS

GET THE ADVANTAGES OF G-E FHP MOTOR PARTS

Designed to Meet Your Requirements

General Electric can supply sturdy motor parts having the correct electrical and mechanical characteristics for your machines. Parts with extremely high starting torque, two-speed-motor parts, and high-frequency-motor parts—these are indicative of the wide range. Parts are available in a wide range of 60-cycle, 50-cycle, 25-cycle, and d-c ratings. General Electric can supply the rotor and stator and any additional motor parts that your application may require, such as a switch or end shield.

Same Performance as in Complete Motors

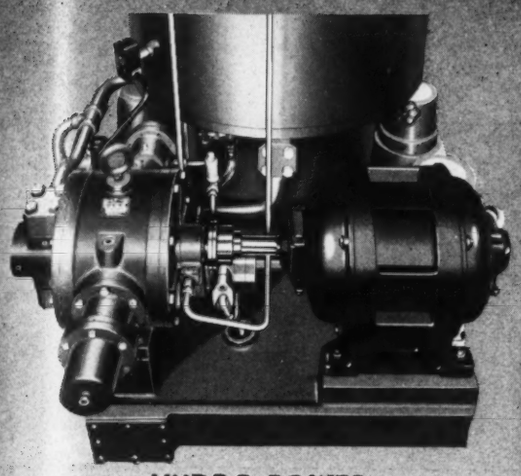
G-E motor parts receive the same careful attention as assembled motors. They have ample overload capacity and are built to give long, quiet operation. The cast-aluminum rotor is inherently well balanced, is practically indestructible, and has permanent electrical characteristics. Stators are constructed to stand long, hard service. The windings are insulated with the best materials known to resist moisture, oil, and mild acids and alkalis. Every part is checked before it leaves the factory.

Benefit of G-E Engineering Service

G-E engineers have successfully applied motor parts to production machinery for many years and will gladly work with you—not only in selecting the correct parts but also in providing ventilation and lubrication and in maintaining alignment and clearances. These points are vital to the satisfactory performance of motor parts in your machines and are thoroughly understood by G-E engineers whose assistance is yours for the asking. Contact the nearest G-E sales office or write to General Electric, Schenectady, N. Y.

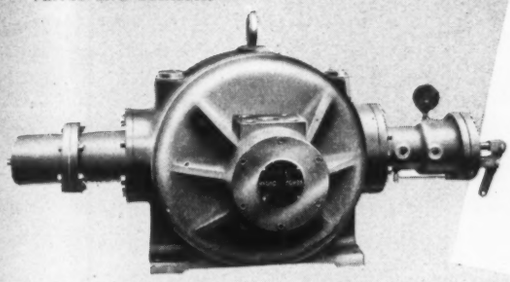
GENERAL ELECTRIC

070-281



HYDRO-POWER
Complete Drive Units

The complete Hydro-Power Closed Circuit drive unit integrally mounted overhead at the rear of a hydraulic press. ● The Hydro-Power line includes complete drive units—radial pumps with an entirely new operating principle—gear pumps—valves and controls.



HYDRO-POWER
Models 4R and 6R Radial Pumps

Hydro-Power Models 4R and 6R Radial Pumps for generating high pressure, hydraulic power for press and machine operation, strike a new note in radial pump efficiency. In addition to the radial pump characteristics including variable and reversible delivery, they introduce a new mechanical relationship between the pump pintle and rotor that eliminates the shortcomings of conventional design.

MEMO

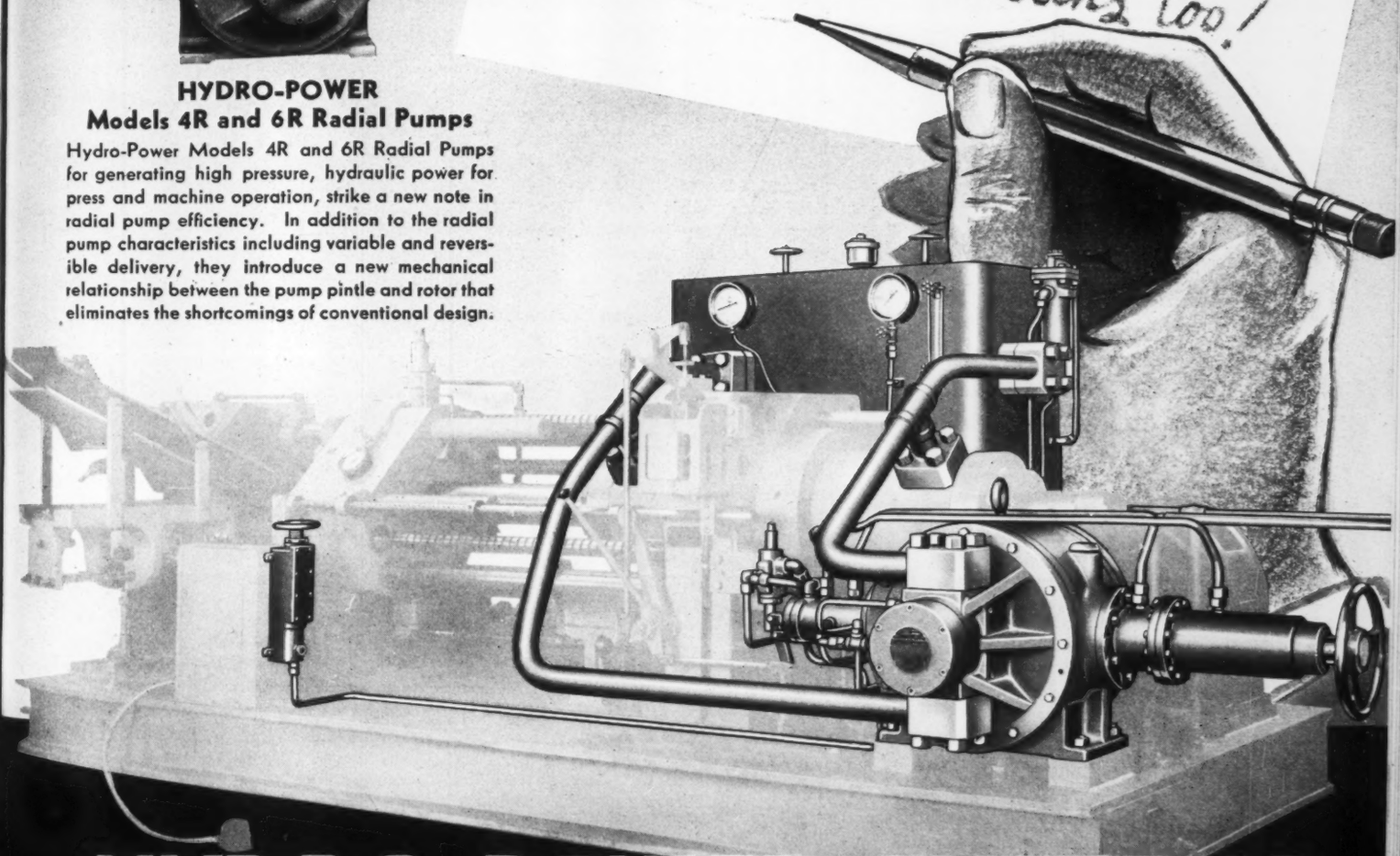
Call in a HYDRO-POWER machine drive engineer

COMPARE Hydro-Power drives with our present drives.

Looks like they've got something!

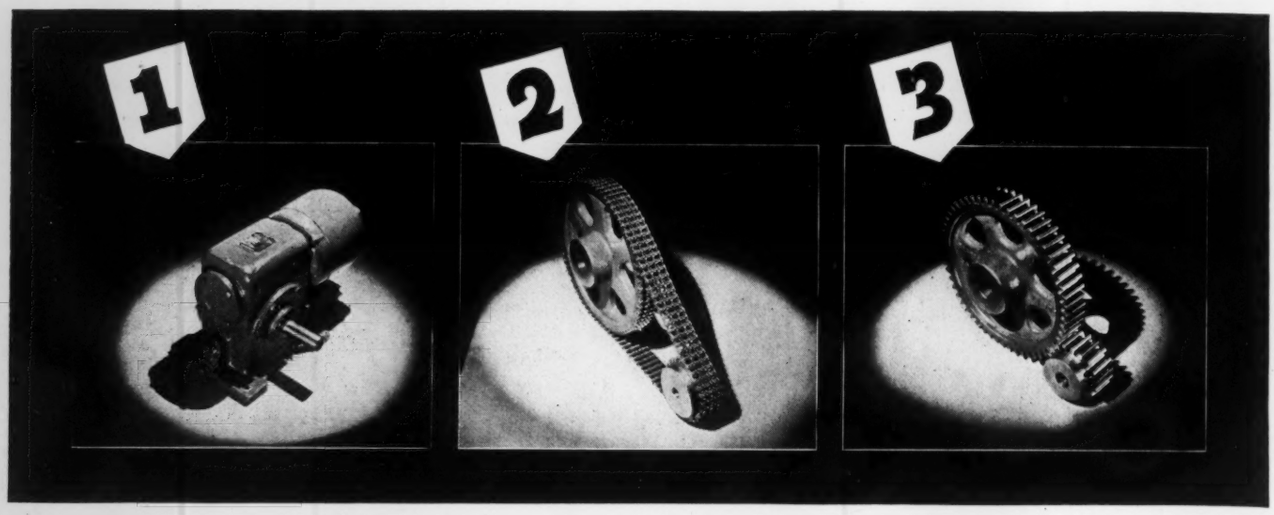
Modern New type Radial Pump - Patented System - Complete Service

Write for Bulletins too!



HYDRO-POWER SYSTEMS Inc

MOUNT GILEAD, OHIO, U.S.A.



How shall I rig up that drive?

1 SPEED REDUCERS

In olden times speed reducers were practically unknown and when a large ratio of reduction was required, one had to resort to a complicated train of open gearing that was cumbersome, noisy and a constant threat to life and limb. To overcome these objections, inclosed gearing or speed reducers were gradually developed until at the present time, the modern speed reducer or motorized speed reducer is in fact a finished machine designed and built to economically, quietly and safely provide almost any required ratio of reduction.

Boston Gear Works, Inc. offers a wide selection of over 600 ratios, types and sizes of modern speed reducers and motorized speed reducers, 95% of which are carried in stock ready for immediate use.

2 CHAIN DRIVES

In every day parlance or in the mind of "the man on the street," chain drives are commonly thought of as being used on bicycles and on motor trucks, but in the mind of the industrialist, chain drives play a very important part in the transmission of motion or power between parallel shafts.

Chain drives are flexible, they are positive, they are up to 98.5% efficient, and they are admirably suited for drive conditions requiring speed reduction ratios up to 6 to 1.

Boston Gear Works, Inc. offers a complete chain drive service ranging from "flea" power to one hundred horsepower. Then too, chains and sprockets for these drives are carried in stock ready for immediate shipment.

3 SPUR GEARING

Spur gears have been used from earliest times with but little change except in the matter of refinement and today they are used more frequently than any other type of gear. At one time spur gears with cast teeth were used quite extensively, but due to the constant cry for more power, speed and efficiency in the modern machines, this type of gear has been displaced by machine cut gears which use less power and operate with less noise and greater efficiency.

Boston Gear Works, Inc. offers a complete line of machine cut stock spur gears ranging from 3 to 48 diametral pitch and in sizes from less than ¼" up to 40" in diameter.

BOSTON GEARS

Here's something very important; for your convenience all of these speed reducers, chain drives, spur gears and in fact all Boston Gear Products are carried in stock in 75 locations throughout the U. S. A. and Canada. Send for a copy of our General Catalog No. 52 which gives complete specifications and list prices of all Boston Gear Products and the names and addresses of distributors who carry complete stocks to serve you.

BOSTON GEAR WORKS, INC. NORTH QUINCY, MASS.

That mellow, foaming stein of good-feliowship owes some of its goodness to Cuno *continuously-cleanable* filters: smart brewmasters drop a handful of dry hop leaves and berries into each vat just before bottling. That's for flavor . . . but it must be taken out. So portable Cuno filters trundle from vat to vat. And breweries protect themselves efficiently, *economically*, and continuously.

WE CAN SHOW YOU HOW TO SAVE MONEY IN YOUR DESIGN

Yes, *you* can save money, not only on filter replacement costs, but also in actual time savings. If you work with any fluid — no matter what it is, nor how much of it there is, we can strain it continuously. No duplex installations. No shutdowns. It's the exclusive Cuno principle of edge filtration . . . with positive mechanical cleaning.

A flick of your wrist cleans a small Cuno. A motor cleans a large one.

OF INTEREST TO DESIGN ENGINEERS

More about this — and other vitally interesting data on *your* industry — in a new 28-page book. Write for it: "80 Ways to Make More Money." It's on the house, if you use the coupon below.

Cuno Engineering Corporation
266 South Vine Street
Meriden, Connecticut
Please send me, free, "80 Ways to Make More Money."

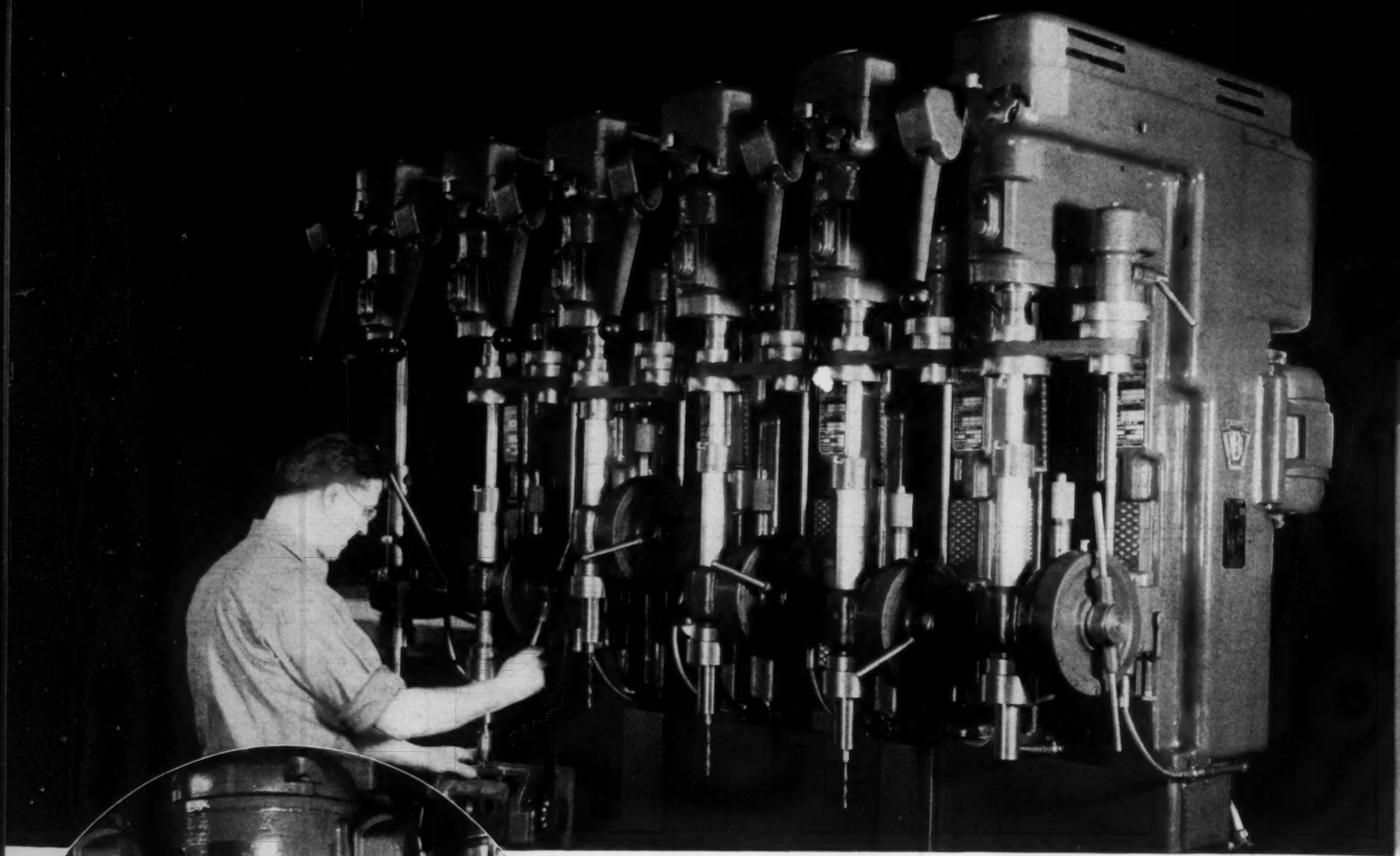
Name.....

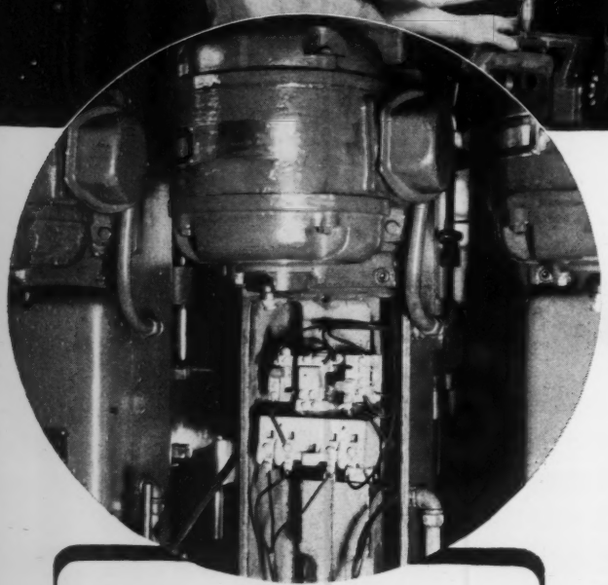
Company..... City..... State.....

Street.....

avoid stop and go with **CUNO** *Filters*

CUNO ENGINEERING CORPORATION ★ MERIDEN, CONNECTICUT





Standardized Westinghouse Drive on this machine consists of:

6 — Spindle drive motors

6 — Linestarter units

1 — Coolant pump motor

1 — Manual Starter for coolant pump motor . . .

BETTER MACHINES FOR LESS MONEY..

VERSATILITY OF WESTINGHOUSE EQUIPMENT HELPS KEEP COSTS DOWN ON NEW AVEY DRILLING MACHINE

By combining drilling and tapping operations, modern drilling machines provide unusual savings in comparison with old design machines. For example, this multi-spindle No. 2 Avey Drilling Machine, drilling and tapping semi-steel castings for small compressors, has effected savings as high as 30%.

Five drilling spindles with automatic feed and one hand fed tapping spindle are driven by standard Westinghouse motors, vertically mounted on rear of the spindle column.

Motor control is accomplished by mounting standard Westinghouse Linestarter units inside the column and immediately below the motor, minimizing wiring connections as shown in the inset.

This typical example shows how standard Westinghouse motors and control can be used to improve machine tools, yet save both first and operating costs. For help in solving your drive problems, call our local office, or address Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

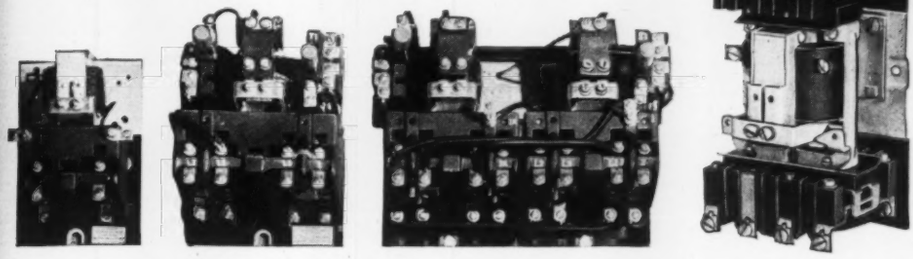
J-90210

Westinghouse

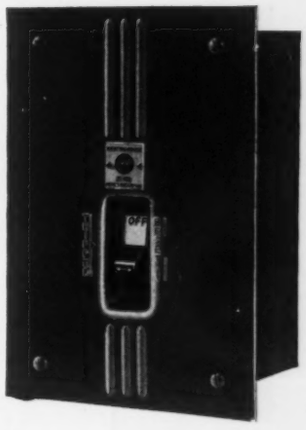
W
WESTINGHOUSE ELECTRIC

SAVE COST OF SPECIALS *with Standardized Drives*

BUILT-IN MOTOR CONTROL FROM STANDARD UNITS



Across-the-line motor starters and contactor units, suitable for practically all built-in applications. Provide motor overload and undervoltage protection and all circuit interlocking functions.



FLUSH TYPE MANUAL STARTER
Manual starter for drives up to 7½ hp. Handle indicates at a glance whether starter is on, off, or tripped.

STANDARD MOTOR AND CONTROL EQUIPMENT IN MANY VARIATIONS SIMPLIFIES MACHINE DESIGN PROBLEMS

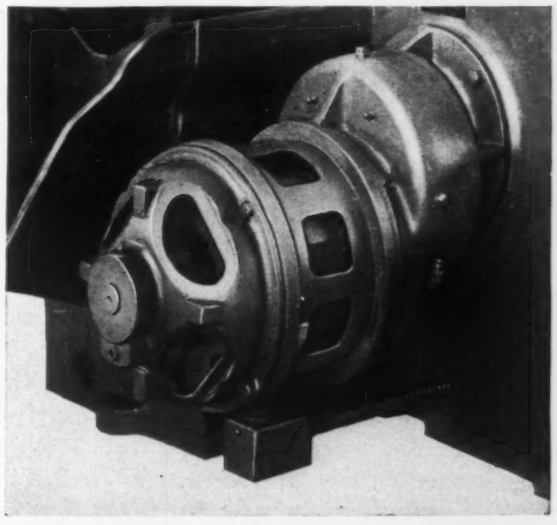
VERTICAL MOUNTING TYPE

STANDARD HORIZONTAL BALL BEARING MOTOR GOOD FOR VERTICAL OPERATION AND FREQUENT REVERSALS

Provides the necessary torque for drilling applications and handles frequent reversals on tapping.

GEARMOTOR TRANSLATES THE POWER DIRECT TO THE REQUIRED RPM

Let gearmotors solve the problem of motor output speed. Simply specify the horsepower and rpm of the driven machine and get the answer in one space-saving unit.



GEARMOTOR FOR FLANGE MOUNTING

Motors and Control

Topics

SEVERAL years ago the Rust brothers of Alabama and subsequently Russia were the centers of a furor raging around the question of what should be done when a machine like their cotton picker comes along and threatens to wreck the existing economy of a whole section of a nation. Realizing the potential dynamite in their position in the South, where immediate displacement of manual labor would create a serious social dilemma, the Rusts packed off to Sovietland where the economic system has not become as fixed and where social quandaries are the rule, not the exception. A recent patent granted to an employe of the federal soil conservation service concerns a harvesting machine which is vaguely reminiscent of the Rusts' invention. The harvester strips grain from wheat and other cereal plants and leaves the stalks standing, hence grain can be harvested in wet weather. Cutting of stalks and binding of sheaves pending threshing is unnecessary. Moreover, the stripped stalks can be plowed under to enrich the soil.

♦

AUTOMOBILES made entirely of plastics are a distinct possibility of the future, according to some authorities, but one requirement stands in the way: Plastics must have the same physical properties as the metals they replace. That sounds like a large order—and it is—but despite the skepticism of the automobile industry, improvements in synthetics undoubtedly will lead to their increasing use in cars, if not to overall utilization. Gordon Saunders, Chrysler Corp., recently pointed out some of the properties plastics must attain before seriously challenging metals for supremacy in vital parts: Tensile strength of at least 40,000 pounds per square inch, an equal compressive strength, and a shear strength of at least three-fourths that figure; constant strength up to 500 degrees Fahr., and down to 50 or 60 degrees below zero; coefficients of expansion near that of steel; properties obtained by alloys in metals, such as variable strength, ductility and hardness secured through treatment; much shorter molding time; ability to be repaired; safety factors, rendering parts fireproof and shatterproof, and capable of absorbing the energy of a crash. A car with a plastic body and other parts is being demonstrated at the World's Fair.

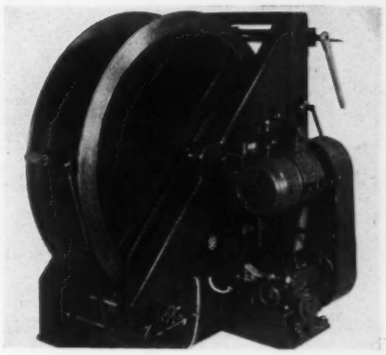
♦

IN-LINE engines have held the spotlight in recent aircraft development as greater speed is sought, particularly in military planes. Menasco Mfg. Co. has also taken an aeronautical step forward, but it is a peaceful one in the direction of safety. The Menasco "Uni-Twin" engine, built to power a new Vega airplane, is actually two separate inverted six-cylinder aircooled engines of 260 horsepower each, mounted closely side by side and geared together to drive a single propeller. A single throttle controls them both, however, and if one engine stops the plane continues serenely as if a single engine had merely lost half its power. The dead engine is cut out by a set of overriding clutches. Smaller pleasure planes are expected to be the first beneficiaries of this new development and it is conceivable that smaller twin engines, priced reasonably, may break down some of the fear of air travel.

♦

CONSTITUTING about one-fourth the bulk of all wood, lignin up to now has been primarily a nuisance after cellulose has been extracted from the wood for making paper or rayon. But now by combining lignin with hydrogen, chemists of U. S. Forest Products laboratory, Madison, Wis., have discovered five new products: Methanol or wood alcohol; three complex organic compounds, one useful as a lacquer solvent and wood preservative, the other two as possible plastics; and a crystalline substance, possibly useful in the manufacture of lacquers and waterproof adhesives.

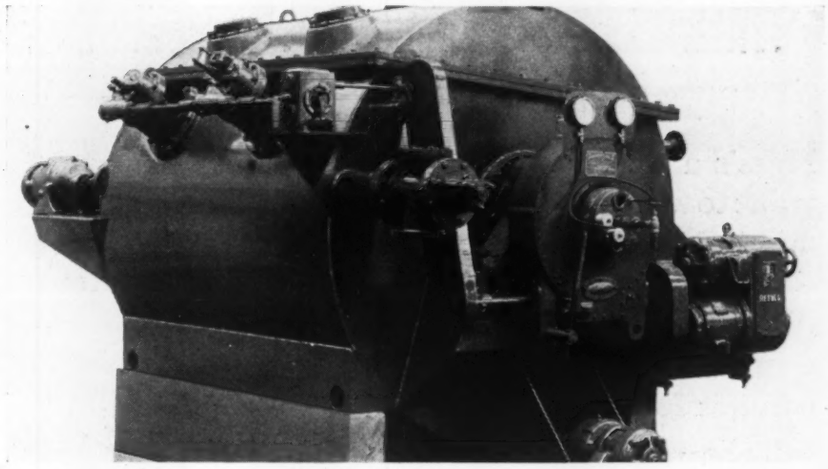
WHAT'S NEW IN SPEED CONTROL APPLICATIONS



ON COIL CRADLE

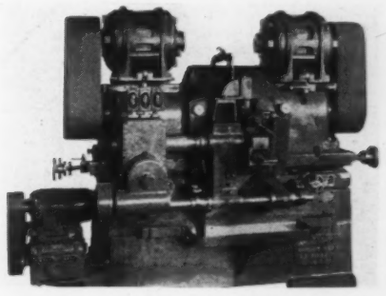
This new cradle for flat coil stock up to 3,000 pounds in weight and in widths from one to eight inches, is equipped with a REEVES Vari-Speed Motor Pulley, permitting close adjustment so that the motor runs constantly, rebuilding the loop at the same rate that it is consumed.

ON MODERN PRECOAT FILTER



To lend versatility and adaptability to the filtering of liquids of varying viscosities, the manufacturers of this Oliver Precoat Filter have provided infinitely variable speed control with a REEVES Motodrive as standard equipment. Continuous clarification of glucose, zein, fruit juices, and other food products, lube and vegetable oils, pigment liquors and other similar products—each requiring a different filter speed—is efficiently effected in numerous commercial applications.

Not only for its proved dependability, but also because the name REEVES is so widely and favorably known, more machine manufacturers use REEVES Speed Control as standard equipment, than any other method.

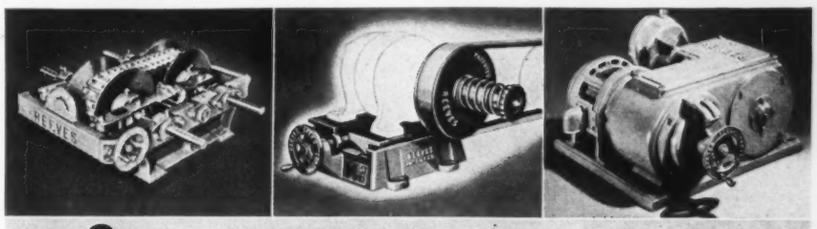


ON GRINDER

Operators of this Grinder can vary spindle speeds instantly and accurately according to different sizes and types of work by means of the REEVES Variable Speed Transmission with which the machine is standardly equipped. Proper cutting speeds facilitate production, reduce power consumption and wear on grinding wheel. Complete protection against abrasives and moisture is provided.

REEVES ADVANTAGES FOR MACHINE BUILDERS

Starting with *three basic units*, REEVES builds a complete line of Variable Speed Transmissions, Motodrives and Motor Pulleys, in a wide range of sizes, designs and controls. This insures a correct and convenient installation for your individual needs. Give your machines the many advantages of REEVES Speed adjustability—*the speed control your customers know best and trust the most.* Send for catalog G-384 which describes the complete REEVES line and its use by over 1300 machine builders. REEVES PULLEY COMPANY, Dept. H, Columbus, Indiana.



THE 3 BASIC UNITS IN THE COMPLETE REEVES LINE

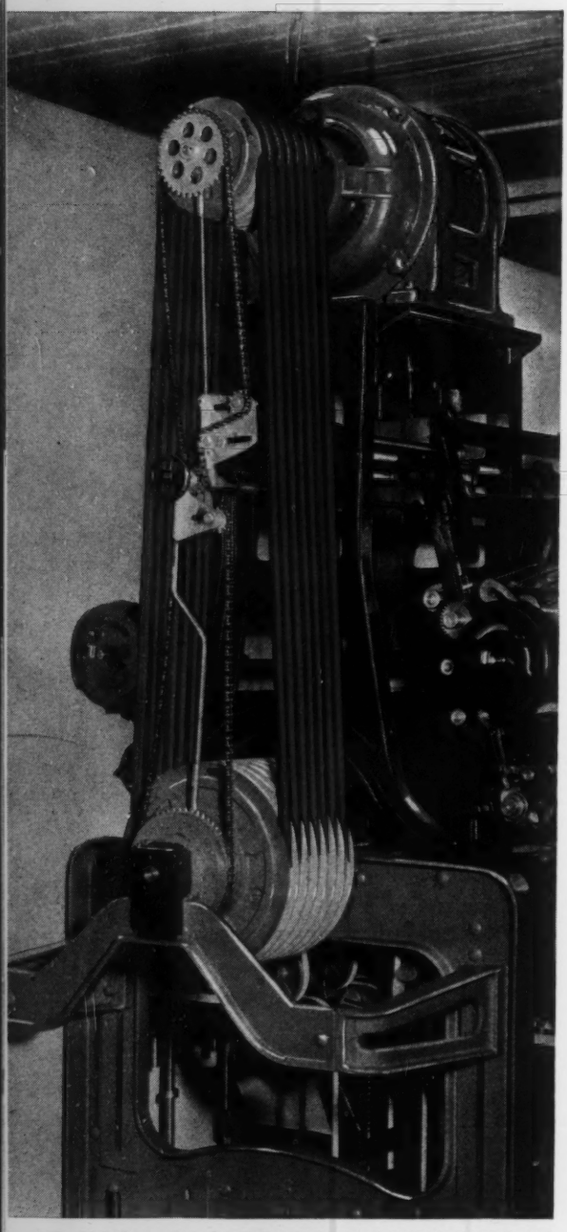
VARIABLE SPEED TRANSMISSION. Provides infinite speed adjustability over wide range. Accurate and positive at all speeds. Modern, compact open and enclosed designs, vertical and horizontal. Sixteen sizes—fractional to 125 h. p. Speed variations from 2:1 to 16:1 inclusive.

VARI-SPEED MOTOR PULLEY. Simplified development of transmission. Mounts on standard shaft of any constant speed motor. Forms direct drive to machine. Sliding motor base is moved forward or back for speed changes. Ten sizes—fractional to 15 h. p.; 3:1 range of variation.

VARI-SPEED MOTODRIVE, Combines in one compact, self-contained enclosure, constant speed motor, REEVES speed varying mechanism and reduction gears (where required). Available in space-saving horizontal and vertical types—¼ to 10 h. p. Speed variations 2:1 to 6:1 inclusive.

REEVES SPEED CONTROL

HOW TEXROPE COOPERATIVE ENGINEERING HELPS YOU WIN CUSTOMERS!



IT TOOK COOPERATIVE ENGINEERING to work out the highly effective driving arrangement on the textile mill equipment shown here — with Texrope engineering furnishing Texrope Drives and Vari-Pitch Sheaves for conveniently changed speeds.

Read How Allis-Chalmers Texrope Cooperative Engineering Gives Added Sales Appeal to Your Products ..Attracts New Customers..Increases Your Sales!

Here's a tip for you! If you want to win new customers... and hold old ones under today's tough competitive conditions — use the most modern, most efficient drives you can get for your equipment!

That means using Allis-Chalmers Texrope Drives — proven by thousands of up-to-the-minute equipment installations!

For when you call in Allis-Chalmers Texrope engineering to work cooperatively with your own design engineers, you get the unlimited advantages of huge research and testing laboratories . . . tremendous manufacturing resources . . . and over 90 years of engineering experience in supplying the advancing needs of industry!

And, of course, that's onl half the story. For when yo use Texrope Drives, you giv your customers long-lif drive equipment that i everywhere setting new eff ciency and new low-cos standards of performanc It's what they want . . . an what it will pay you to giv them . . . and pay you big

Get Texrope Facts!

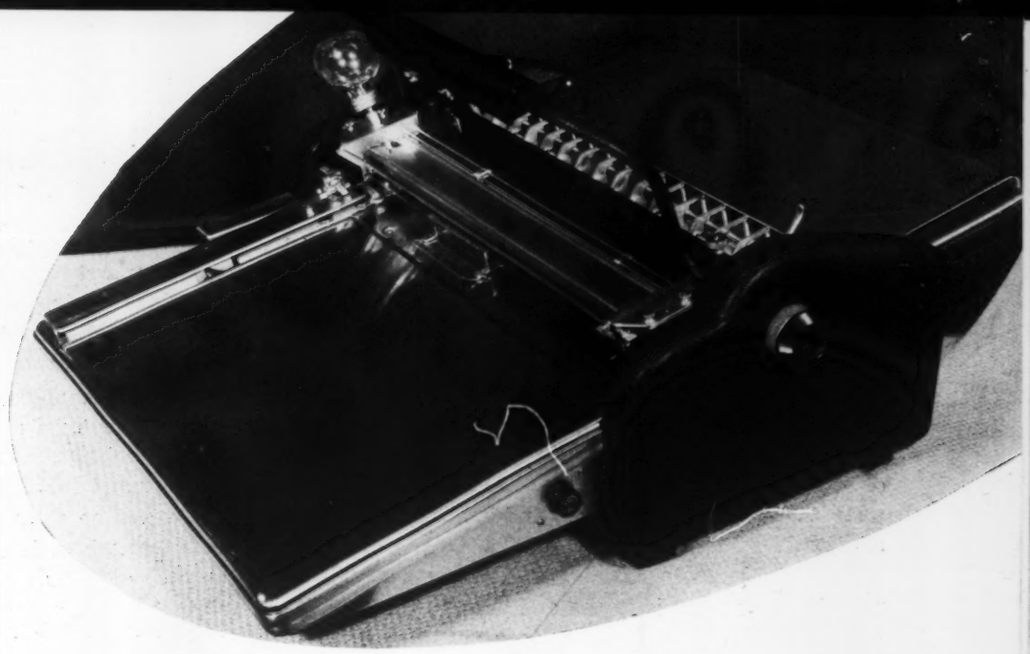
Find out about the complet line of Texrope drive equip ment — why it is first choic among design engineers .. why your customers prefer it

For full details, call th trained transmission engi neer in the nearest Allis Chalmers district office. Te him your drive problems .. let him put Allis-Chalmer Texrope cooperative engi neering to work for you

Vari-Pitch Speed Changers • Texrope V-Belts • Duro-Brace Texsteel Sheaves • Vari-Pitch Sheaves • Standard Cast Iron Sheaves • Adjustable Pitch Diameter Texsteel Sheaves • 2-3-4 Combination Sheaves • Straitline Automatic Motor Bases • Oil Field Drilling Rigs

Belts by Goodrich

TEXROPE DIVISION
ALLIS-CHALMERS
MILWAUKEE·WISCONSIN



For Good Design—Economize

By A. W. Mills
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SECOND only to performance of machines are the provisions for economical manufacture. Simplification of parts, selection of materials, choice of production methods—all contributing toward design economy—were major considerations in the development by the International Business Machines Corp. of the new transfer posting machine illustrated in *Fig.* 1.

This machine transfers records line by line to other sheets or forms. Hence the general design of the machine centers around the performance of this function as rapidly and conveniently as conditions permit. Transfer posting is accomplished by interposing a ribbon, saturated to the proper degree with a carbon solvent, into the area to be transferred and by bringing the ribbon, master sheet and ledger firmly together. Obviously, any movement of any of these parts other than vertical, would result in a smudged print. This is

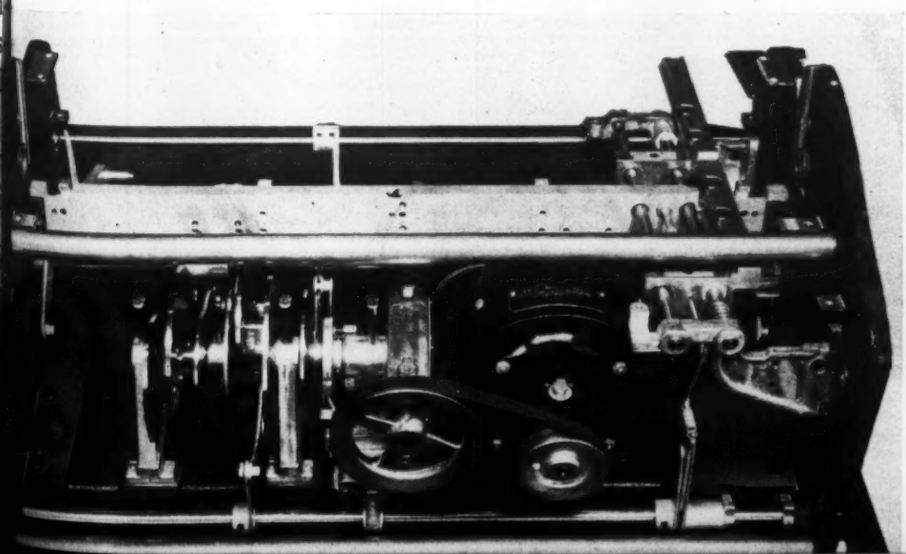


Fig. 1—Top—In addition to neat appearance this machine for transferring records embodies economical design. Fig. 2—Left—V-belt drive through worm gear reduction operates cams for controlling sequence of machine functions

especially true immediately following the transfer. Suitable strippers are provided to separate the wet parts and to hold them so separated for as long as possible before moving them to their proper positions just before the end of the machine cycle.

The sheet which receives the print is automatically returned to its initial position and the sheet from which the transfer was taken is advanced another space. Many parts enter into the required motions actuated by a camshaft and cams. The latter are set, of course, in such positions that the events of the cycle occur in their correct sequence and in accurately timed relation.

An electric motor runs continuously during the period the machine is in use and drives through a V-belt and worm reduction gear to a clutch. The latter is engaged mechanically when the operating lever is tripped and is disengaged automatically at the end of the cycle. An interlock is provided so that the machine cannot be operated without first placing the papers in the desired positions. *Fig.* 2 shows the arrangement of motor, worm gearing, clutch and camshaft. These parts are mounted on a cast iron base fastened to the end frames.

In general design the machine is composed of two die cast zinc alloy side frames fastened together by shafting necked at each end. Another connecting member is a bar of cold rolled steel having a ground upper edge. This bar, fastened to bosses on the side frames, provides the surface against which the paper bears at the instant of printing.

Rigid framework is provided by this assembly to maintain accurate alignment of bearings for cross shafts which are journalled in bronze bushings set into other bosses on the frames. Positions of these bushings and their arrangement are indicated in *Fig.* 3. This drawing of the left side plate shows bushings in place. All parts in the frame assembly lend themselves to rapid production at low cost.

In this connection it may be said that the side frames require a minimum of machine work consisting of light cuts which include chiefly the reaming of holes and facing of bosses. Reaming of most of the holes is done simultaneously in a single operation in a fixture which insures that the holes have not only correct center distances but are held accurately at right angles to boss faces. In *Fig.* 4, a side view of a partly assembled machine is shown, the frame and parts of the mechanism attached to it including operating lever in right foreground.

Complementary Cams in Small Space

Slots cored in some boss faces form oil holes, the open sides of which are closed subsequently by bushing flanges, thus saving separate drilling of the oil holes. Again, slots for the pressure bar slide have coring and bosses so placed that it is unnecessary for the milling cutter to remove metal at inside corners.

To give the required motion to various parts, use has been made of complementary cams which provide required dwells where needed in the cycle and avoid the use of return springs which may give trouble in service. In other words, forward motion is imparted

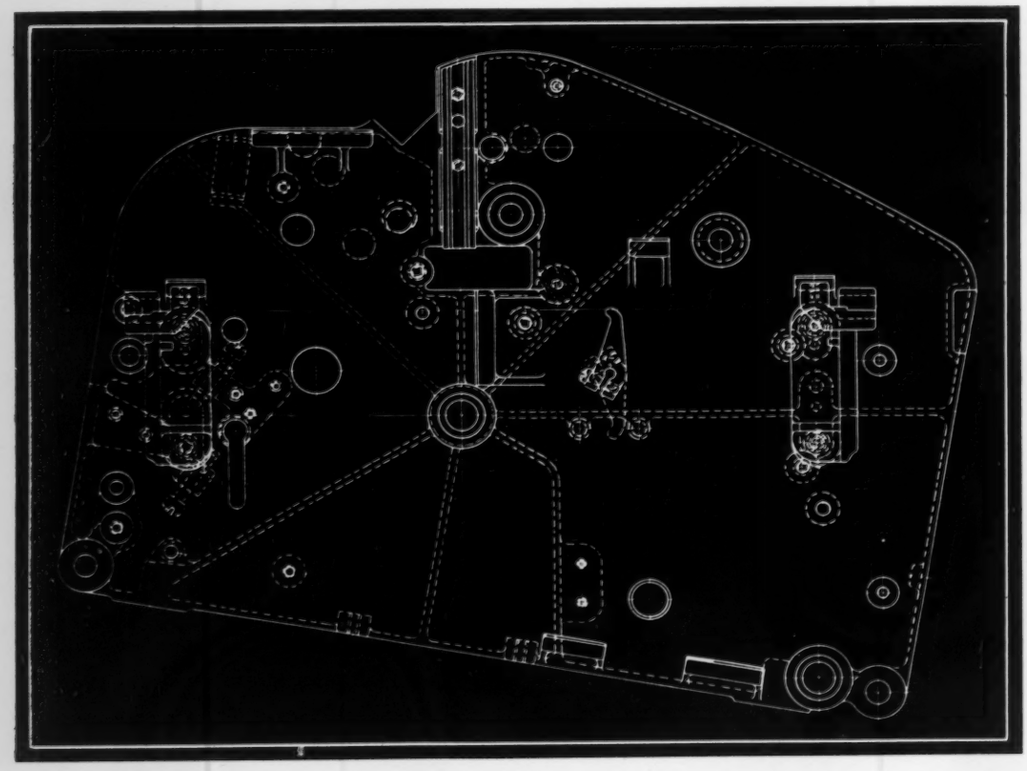
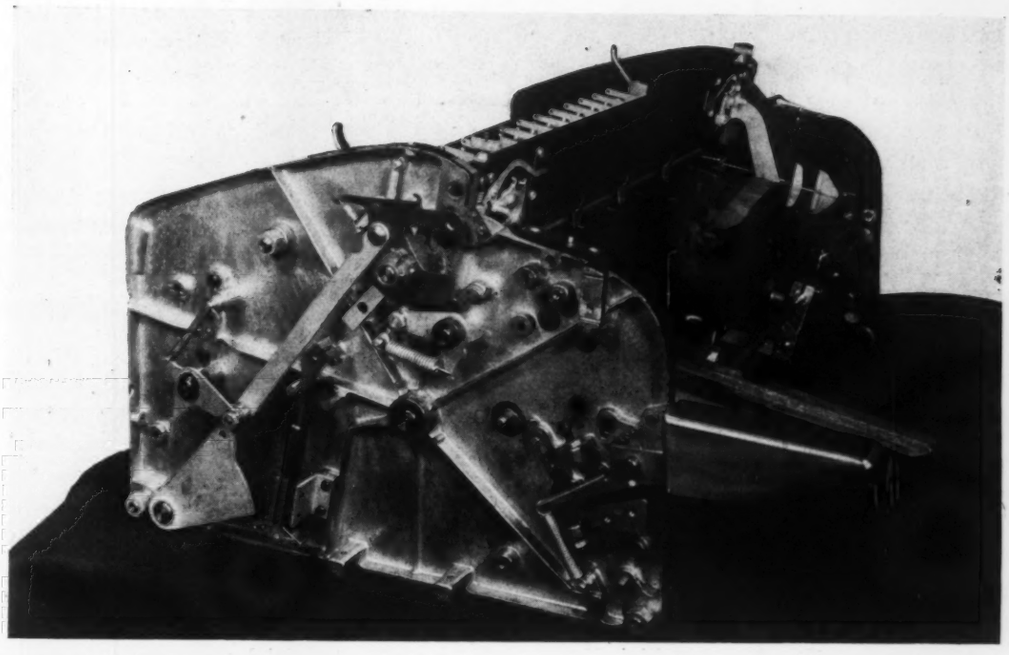
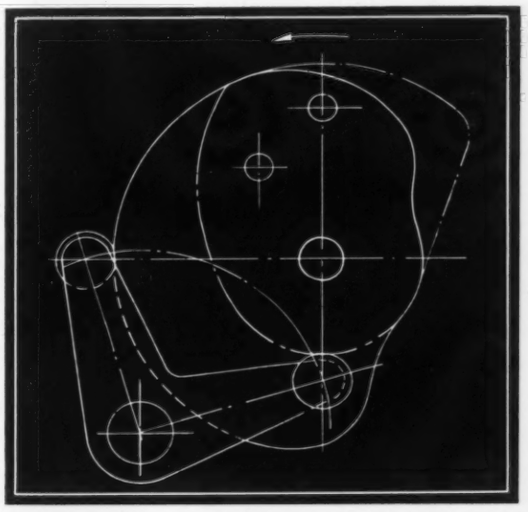


Fig. 3—Drawing of die-cast side frame showing some bushings and levers in place. Simple coring at bushing bosses provides the oil holes

Fig. 4—Side frame with parts of mechanism attached are seen in this partly assembled view. Fig. 5—Below—Active and complementary cams impart positive motion in both directions





by one cam and return motion by the complementary cam, the motion being positive in both directions and with backlash held to a minimum by accurate milling of cam contours. Design of one of these pairs of cams is shown in *Fig.* 5. This type was chosen when the operations performed were considered too severe to be handled by springs. The enclosed type of cam was eliminated primarily by space limitations.

Cams are 4150 steel heat treated to produce 25 to 30 rockwell C hardness before the contour is milled. This yields a surface hard enough to be highly wear resistant but yet machinable, whereas if case hardening after machining were done some distortion and growth would result and require subsequent grinding. Cam follower rollers are the outer race of ball bearings. Precautions are taken to avoid wear and resulting backlash at other points so that a minimum of adjustment in service will be required.

Most of the operating shafts except the camshaft have their bearings in bushings carried in the side frames, but as the slide which moves the lower paper into position and returns it has a reciprocating motion parallel to the side frame, other provisions for guiding it are made. The guides are shafts supported in die cast brackets which are fastened by screws to bosses on the side frame and are dowelled after assembly in correct alignment. The slide itself is a die casting which is produced in one piece, replacing a former proposed assembly consisting of seven parts.

Although full advantage is taken of stamped parts where they result in a net economy in this machine, several small one-piece die castings are utilized rather than assemblies of stampings and screw machine parts involving two or more pieces.

Parts designed to be mounted permanently on cross shafts are die cast with split hubs fastened by screws. This has proved preferable to the use of similar parts without splitting and depending on taper pins. Split parts have been found less likely to loosen, are adjustable, and do not require drilling and reaming holes in the shaft at assembly. Many split collars of this type are used.

Another expedient employed, especially in parts which must slide freely on two parallel shafts, is to die cast the part proper and also one or two bearing caps, as required. Holes for screws used in fastening the caps are cored slightly larger than the screw, thus allowing for slight adjustments of the pieces at assembly. Once adjusted, the parts are dowelled.

Certain of the larger sheet metal parts as seen in *Fig.* 1, including the parts forming the inclined working surfaces, are produced by blanking and bending operations with welds at the corners where bending brings edges together. This avoids the expense of large

(*Concluded on Page* 86)

Scanning the Field For Ideas

Five Cams Control Teletyper

CAM assembly allowing one or more of five contacts to close in sequence and in various combinations produces thirty-two different signals for remote operation of a new teletypewriter of simplified design developed by Teletype Corp. These signals, obtained by depressing keys at the sending machine, reproduce typed pages at receivers by the different combinations of five current-on or current-off intervals. Twenty-six are used for the alphabet and the others for functions such as feeding the paper, returning the carriage and shifting. The shift signal brings into action a second row of type with numerals, fractions and punctuation marks.

In the receiving mechanism, the five component impulses of each selection are sorted by a timing mechanism and transmitted to five code disks as shown in *Fig.* 1. Slots on each disk conform to the signal code. On receipt of each signal, disks turn to bring slots into line at one point. Pins are mounted around the disks like a crown and press against them so that each spans all five disks.

For each combination of impulses, one pin enters a lineup of slots. A stop arm, turning integrally with a type wheel, rotates over the disks until it strikes a pin. A printing hammer then operates, striking the type in position at the platen. This drives type and an inked ribbon against the paper and types the character selected. A spacing mechanism moves the carriage one space after each typing operation.

When a shift or upper case signal precedes a character, type rises higher and hammer strikes lower line of type on wheel. For carriage return and new line spacing, the stop arm assumes a position in a similar manner to typing a character. However, at the lower end of stop arm shaft a spider arrangement is provided, co-acting mechanisms performing the functions desired.

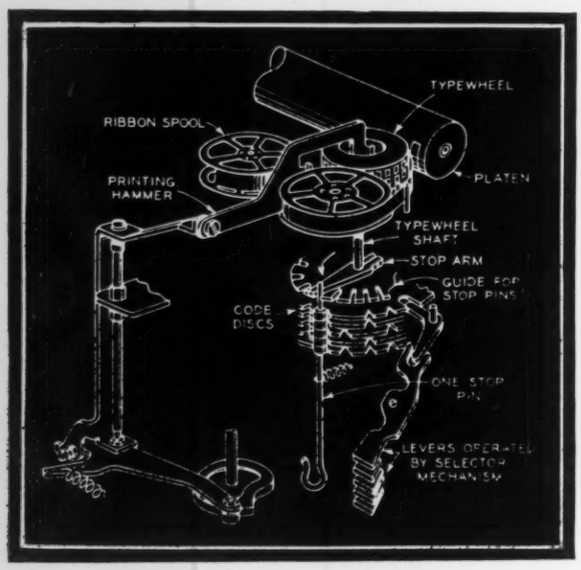


Fig. 1—Receiving mechanism showing cam alignment for type selection and printing

Flexible Cells for Tanks

FLEXIBLE, lightweight, corrosion resistant fuel tanks using metal only as a frame to hold them in position give promise of being a solution to an old problem of vibration and corrosion. These twin enemies become important when weight-gallonage ratio must be low as in airplane gasoline tanks and tank trucks and where tanks carry sour crudes or other corrosive fluids.

Known as a Mareng fuel cell, the bag or inner cell of the tank is constructed of chloroprene rubber and installed in much the same way as an inner tube in a tire casing. The fuel cells are designed to be slightly larger than their compartments so that all strains are carried by surrounding structure and the cells serve only as static, vibration-proof and leak-proof containers. Sloshing of fluid is reduced and waves which otherwise might build up are dampened.

Damage due to accident is easily repaired, as with an automobile tire. Spare bags, light in weight and reduced in bulk because of their flexible nature, are easily carried. They are not affected by most petro-

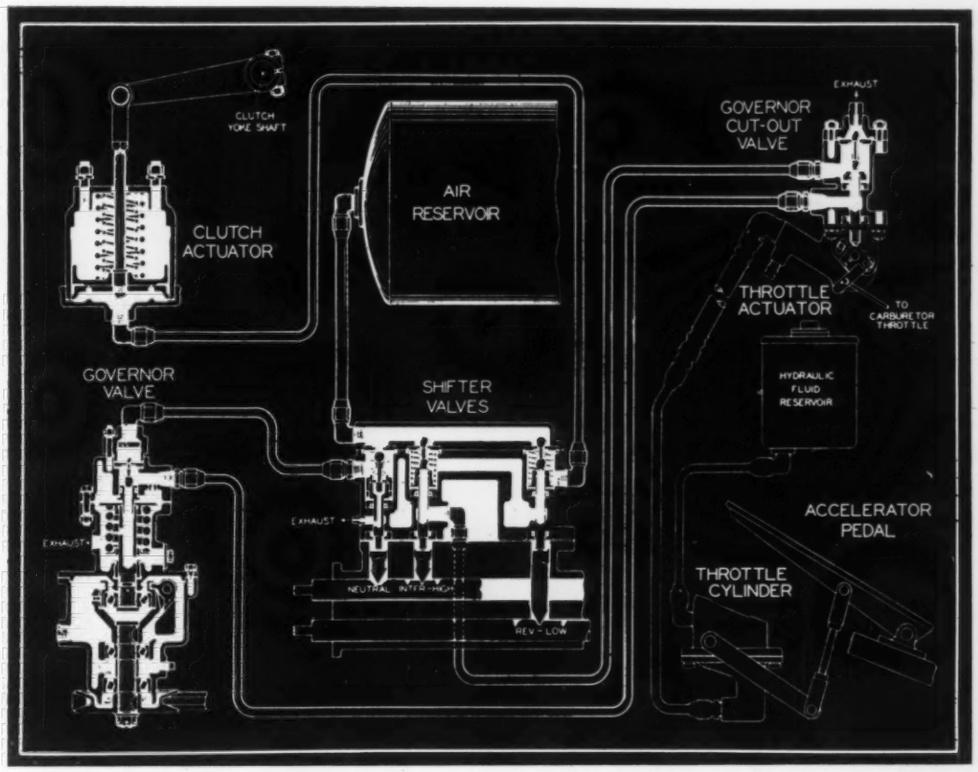


Fig. 2—Clutch operated by compressed air engages automatically at speeds determined by the throttle opening

leum hydrocarbons or salt water. Sizes up to 185-gallon capacity have been used successfully. This application was developed by engineers of the Glenn L. Martin Co.

Bolts Hidden in Assembly

AN OUTGROWTH of so-called "streamlining" are machines without visible bolt or screw heads. Completely assembled from the interior, recently designed machines of the American Machine & Foundry Co. present a pleasing appearance as well as a smooth, easily cleaned surface. This is especially desirable for machines that are used in the food industries.

Other designers are employing beading or trim shaped to form a hollow T in which bolt heads may slide, thus facilitating rapid assembly and giving a smartly finished exterior. An office machine employing this type of construction is illustrated on page 33 of this issue.

Clutching Is Function of Motor Speed

AUTOMATIC clutching which operates according to load conditions is being used on motor busses. The driver has no direct control of the clutch, thus eliminating two objections to manual operation, namely, slippage and harsh engagement. As used on Mack busses the automatic clutch always engages at a predetermined pressure and speed.

Comprising four elements mounted on the power plant, the shifter operates on compressed air from the regular brake reservoir. A housing containing three shifter valves, a clutch cylinder, a centrifugal governor for controlling the governor valve, and an hydraulic throttle control which actuates the cut-out valve are shown in *Fig.* 2.

Three separate means of exhausting the clutch actuator permit clutch engagement. The neutral shifter and the cut-out valves are each metered to provide clutch engagement as rapidly as possible without jerking. The third method is actuated by the governor valve and is sensitive to speed and pressure. The governor valve is opened by retraction of an inner ball-valve seat away from the ball. This is effected by the action of the centrifugal governor against resistance of a coil spring so that the rate at which air is exhausted from the value is graduated to the speed of the engine.

Pressure sensitivity of this valve is afforded by a diaphragm whereby the pressure in the middle chamber acts against the governor spring. The higher the pressure in the clutch cylinder line, the more responsive the valve will be to governor action. Thus with the clutch disengaged and high pressure against the diaphragm, relatively small increase in speed will cause the governor valve to exhaust the air. But as this lowers the pressure, the spring will tend to close the valve after partial engagement unless the speed is further increased. It is this sensitive action which prevents violent clutch engagement. Thus the differential action between diaphragm and spring graduates clutch engagement to the rate and extent of motor acceleration.

If there is no pressure in the air cylinder such as

on starting the motor, the clutch remains engaged, with gears in neutral, until sufficient pressure is developed for operation. Moving the gear shift to low or reverse operates valves to engage the clutch only if the accelerator pedal is pressed. In changing from low to intermediate and to high, valves disengage the clutch and engage it again after the gears mesh. In intermediate and high gears the governor has no control.

Sectionalized Tracks Reduce Circuits

SOUND is synchronized with travel in a unique General Motors exhibit at the World's Fair. Providing a show which is always "just starting," the exhibit utilizes a system embodying a huge drum with sound tracks, phototube pickups and sectionalized tracks for reducing the number of circuits required, as shown schematically in *Fig.* 3. A total of 150 pairs of cars is used, each pair being provided with a loud speaker through which are described the scenes being viewed as the car passes the points of interest.

Essentially, the system consists of a steel drum carrying bands of sound film. At 150 equally spaced points the film is pierced by brilliant needles of light which actuate phototubes. Instead of using 150 circuits, which would be mechanically impossible in the space between cars, seven trolley rails are sectionalized into seventy foot lengths with insulating joints. The time required for a car to pass over one section is that required for one revolution of the drum. Each light beam which scans the sound loop for one section is associated with one of the seven trolley rails. Sliding contact is made through silver-impregnated shoes beneath the cars. In this way each car receives synchronized sound in each section. On passing to the next section, the cars pick up the sound at the proper instant.

Synchronization between rotating drum and cars is similar to controls used for automatic elevators. An interrupter-cam, driven by the rotating drum, actuates a make-and-break contact thereby advancing a mechanical selector in step with the drum's rotation. A second contactor is mounted on one car in each conveyor section which makes and breaks contact with a special synchronizing rail located in one of the sections. This circuit advances a second selector with the car's progress. These two selectors are connected with relays which correct any deviation from synchronism. This produces temporary correction only. A motor driven rheostat establishes correction at a slow rate. Thus hunting is prevented.

This ingenious device, called a "Polyrhetor" (many orators), was designed by Electrical Research Products Inc.

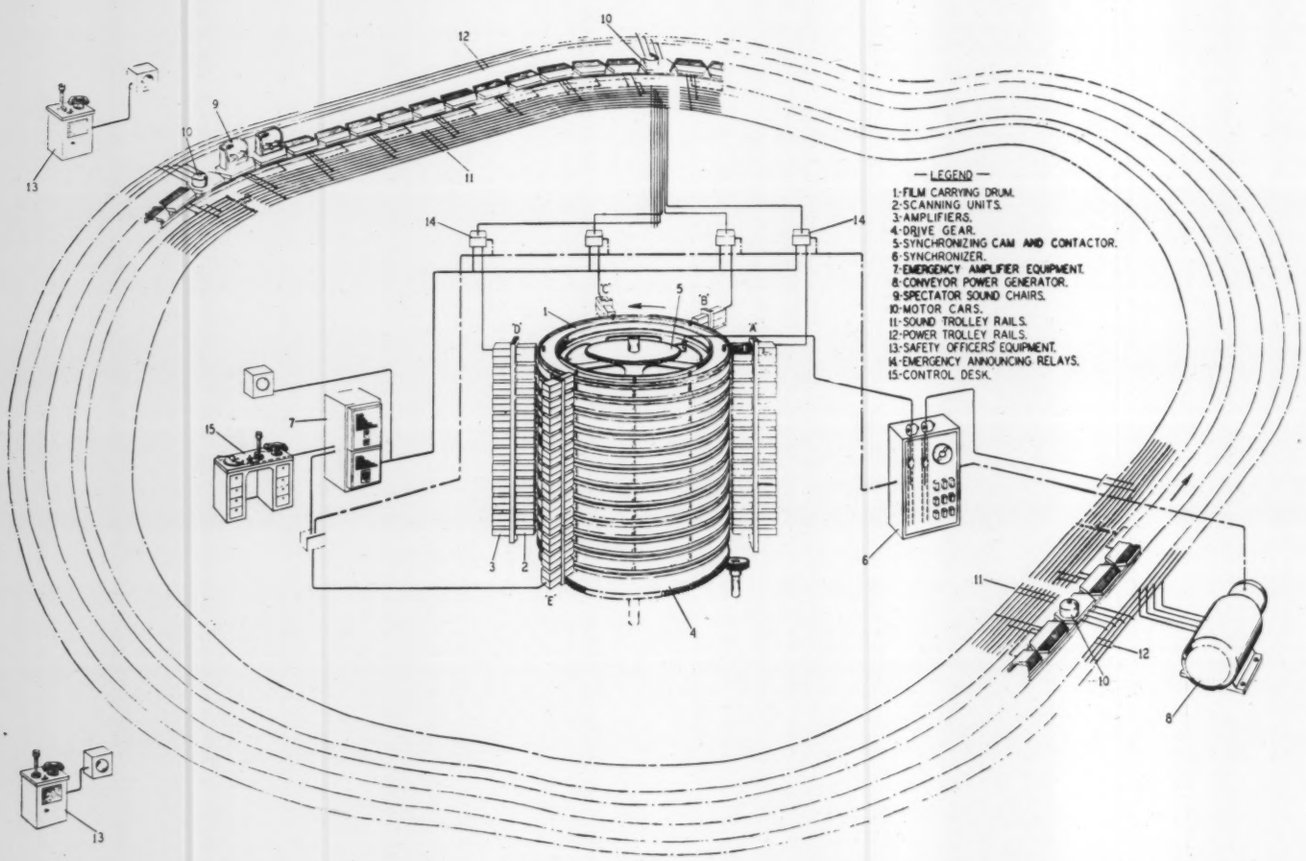


Fig. 3—Schematic diagram showing arrangements for synchronizing sound with spectator cars. Each of the 150 pairs of cars receives a description of the tour en route, accurately timed with the scenes being viewed

Hydrodynamic Torque Converter Supplements Fluid Coupling

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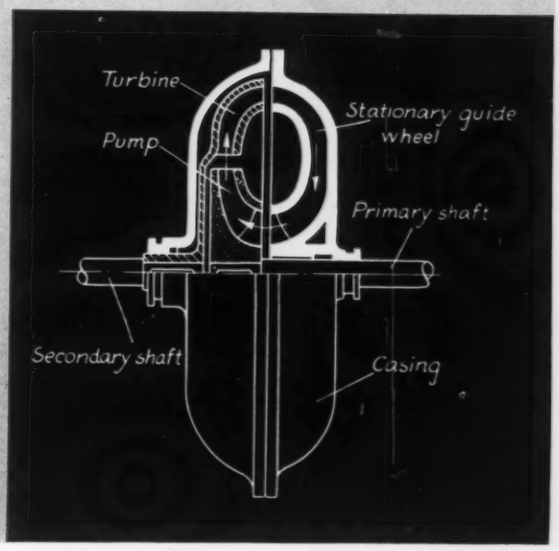

Fig. 1—A hydrodynamic torque converter in its simplest form, consisting of a centrifugal pump connected to the primary shaft, a turbine connected with the secondary shaft, a fixed guide in casing

THOUGH not widely recognized, the hydrodynamic power transmission is destined to conquer a great field in engineering. This paper presents the basic ideas of the hydrodynamic transmission, especially when applied to motor cars. The designation "hydrodynamic" power transmission will be used and not the term "hydraulic" transmission, because all fluid gears working by means of static fluid pressure, like piston pumps, will not be treated, but only those which operate by dynamic action, like turbines and centrifugal pumps. It is the dynamics of turbines and centrifugal pumps which must be understood when the action of a hydrodynamic gear is to be explained. Moreover, a hydrodynamic gear which can take differences of torque between the primary and secondary shaft and which consequently is furnished with one or more fixed blade rows, will be called a "hydrodynamic torque converter." Such a gear consisting of only revolving blade rows, which cannot take differences of torque, will be called a "hydrodynamic coupling."

All modern hydrodynamic gears originate from the invention of Dr. Hermann Foettinger more than 30 years ago. He perceived that by a concentric arrangement of turbine and pump wheels, wherein the fluid circulates through a closed vortex-ring-shaped circuit, a considerable amount of space, weight and friction loss in pipe lines is saved. Furthermore, a characteristic differential action becomes effective by means of which those losses generated by conversion of kinetic energy into pressure energy in turbo machines are avoided completely.

Foettinger also noted that in a hydrodynamic gear, torque conversion is possible only if at least one fixed guide apparatus exists in the circuit between the revolving blade rows. This guide apparatus has to take the reaction against the difference of the primary and secondary torque and to transfer it to foundations of the gear. Finally he perceived that an arrangement of only revolving blade wheels, one series of which is connected to the primary and the other to the secondary shaft, works as a slip coupling, and that the slip can be reduced to a very small figure by giving the primary and secondary wheels proper dimensions.

A hydrodynamic torque converter in its simplest form consists of a centrifugal pump connected with the primary shaft, a turbine connected with the secondary shaft, and a guide apparatus fixed in the casing as in *Fig.* 1. Fundamentally it does not matter where

From a paper given at the World Automotive Engineering Congress, SAE.

the guide apparatus is situated in the circuit. Primary and secondary runners and guide apparatus may be single or multi-staged. In case they are multi-staged a stage of a primary runner must be followed by a stage of a secondary runner or of an apparatus for guiding.

The most essential attribute of a torque converter, which is also the most important one regarding motor-car driving, is that, with constant primary torque T_p, the secondary torque T_s may change within wide limits. Typical characteristics of such a torque converter are shown in *Fig.* 2, η indicating efficiency. It is drawn for a constant primary speed, and the primary torque absorbed by the converter is assumed to be not depending on the secondary speed. This is often the case with torque converters, although such a property can be influenced willfully by designing the bladed systems of the runners and the guide apparatus, for instance, so that the primary torque (the primary speed being constant) increases when the secondary speed approaches zero. In any case, with the secondary speed zero, the secondary torque has its maximum, which we may call "starting torque" (T_{st}), it decreases uniformly towards zero. This point being reached, the secondary shaft is running idle. Between

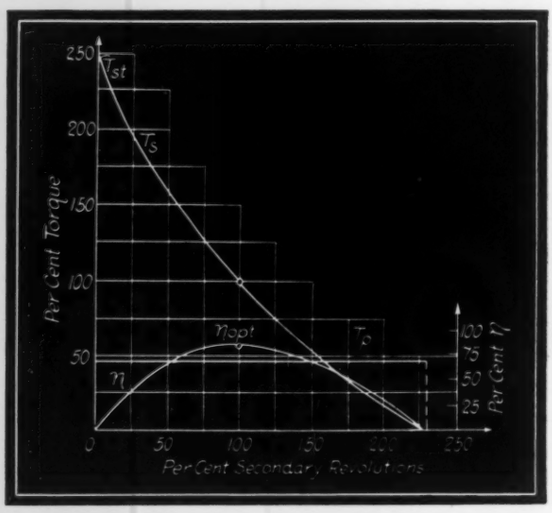

Fig. 2—Typical characteristics of a torque converter. With a constant primary torque, the secondary torque may change within wide limits

these limits the efficiency varies similarly to a parabola having its maximum with a secondary speed which is about half the idling speed.

To understand further the operating properties of torque converters, it is necessary to know how torque and power vary with the primary speed—this value being constant in each case—and with the seize of the converter. To obtain such understanding we use again the laws of similarity holding good also for converters. Hydrodynamically similar operation, of course, is only possible with geometrically similar torque converters of different seizes. Geometrical similarity existing, the hydrodynamic conditions are similar provided that the ratio of primary and secondary speed is the same. In this case, torque ratio and efficiency are the same too. In other words, torque ratio and efficiency depend only on speed ratio.

Let us now consider how a torque converter of a given type fits in motor-car drive when it is interposed between the motor and the rear-axle gear, that is, when neither a clutch nor a mechanical shifting gear is installed additionally. The method of studying this question is exactly the same as with the coupling. In a graph (*Fig.* 3) which contains the secondary torques available with several constant primary speeds on the secondary shaft and plotted against the secondary speeds, we draw curves of torques required to balance the drag. The intersection points of both kinds of torque lines determine the operating conditions of the torque converter, that is, the primary speed n_p and the speed ratio i which are necessary for developing the secondary torque and, further, the efficiency of the converter.

Comparison of Converter and Coupling

There is of course a fundamental distinction between torque converter and coupling. With a given position of the accelerator, a motor combined with a hydrodynamic coupling has to develop the torque required on the secondary shaft because the coupling does not alter the torque. Therefore and since the torque absorbed on the primary shaft and transmitted to the secondary shaft by the coupling depends both on the primary speed and the slip, the primary speed adjusts itself to the proper value so that the motor can develop the torque and the coupling can transmit it. To the contrary the torque on the primary shaft of a torque converter depends, within the wide limits, only on the primary speed and not on the speed ratio (which here takes the place of the slip). Therefore, the primary torque with a given torque converter varies with the 2nd power of the primary speed but in a degree which still depends on the seize of the converter. This torque must equal the motor torque and, by this principle, the motor speed is determined if the motor is connected with a torque converter of a given type and a certain seize and the accelerator is given a certain position. The maximum speed that the motor can run depends on its torque-speed characteristics for full-gas position of the accelerator and on the seize of the torque converter.

Converter Must Be Combined

The foregoing explanations mean that generally a torque converter must be combined with other elements which make it possible either to locate its secondary torque characteristics into different partial speed ranges of the car, or to restrict its operation to a certain speed range, that is, to eliminate it for the

other speed ranges completely and to replace it within these speed ranges by another element. The first suggestion leads to inserting mechanical shifting gears either between motor and torque converter or between torque converter and rear-axle gear; the second suggestion will be explained later.

There is a difference when a mechanical gear is arranged between motor and converter (that means before the converter) or between converter and rear-axle gear (behind the converter). Inserting a gear behind the converter does not influence the motor or, in other words, the relationship between motor and torque converter.

Gear Between Elements Influences Both

On the other hand, a gear arranged between motor and converter influences the operation of both. The reason is that the primary torque absorbed by a torque converter varies with the square of the primary speed, and the torque developed by a motor depends on its speed after any other law. But, on the secondary shaft, these two different arrangements have fundamentally different effects because the primary speed of the converter is different in both cases and, therefore, the curve of the secondary torque has a different situation and speed range. These conditions depend very much on the torque-speed characteristics of the motor and on the chosen seize of the torque converter. In most cases the only advantage of inserting a gear between motor and converter is to reduce the dimensions and weight of the converter by increasing its speed. The gear to be inserted, in such cases, should be provided with a speed ratio such that the motor with full gas runs at its speed of maximum power.

The second suggestion mentioned earlier involves use of the torque converter only for starting and acceelerating conditions, and temporarily when driving on a grade, and elimination of its operation entirely within the other speed ranges.

Using Converter for Starting

This idea can be carried out in two different ways. One is to connect the primary and secondary shaft by means of a mechanical clutch (for instance a friction clutch). This is done in the Lysholm-Smith gear. Here a double friction clutch connects for the start and for the low-speed ranges, the motor and the hollow shaft of the primary runner of the torque converter. The secondary runner drives through another hollow shaft and by means of free wheeling, the secondary shaft. But this secondary shaft is lengthened through both the hollow shaft of the secondary runner and that of the primary runner up to the clutch, so that, for the higher speed ranges, it can be connected with the motor shaft directly and rigidly. When this is the case both the primary wheel and the secondary runners come to rest. The secondary runner is a three-staged turbine with two guide vane rows interposed. Such an arrangement makes the efficiency curve of the transformer remarkably flat and the maximum efficiency high. This is necessary because the converter is used during relatively long periods. The Lysholm-Smith gear facilitates shifting considerably, which is very convenient especially for bus drive in thick city traffic.

Still better overall efficiency is obtained by the Rieseler gear which adds to the elements of torque converter and clutch a two-staged sun gear and a brake for fixing the guide apparatus in case the converter is working, whereas, on the other hand, this element rotates together with the whole converter for higher speed ranges.

Instead of the foregoing combinations it is possible to arrange two or more stages of purely hydrodynamic transmission. This leads to a hydrodynamic change gear, which fundamentally can consist of a certain number of torque converters and couplings. There can be, for instance, one hydrodynamic torque converter for the start and lowest speed range, another for a higher speed range, and a hydrodynamic coupling for the highest speed range.

The statements presented show the hydrodynamic power transmission has a great many advantages. There are several reasons for the fact engineers have

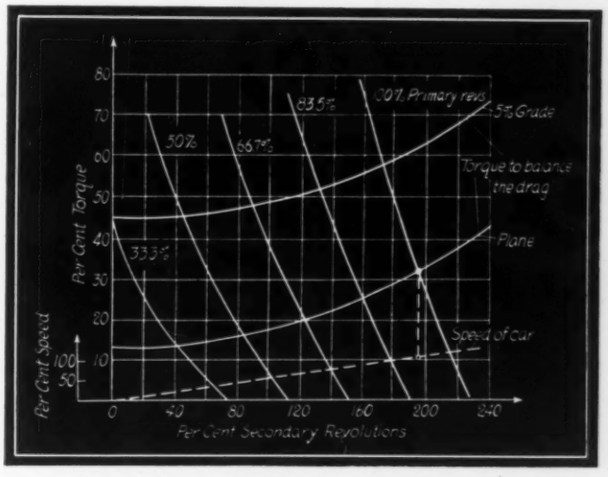

Fig. 3—Intersecting points of both kinds of torque lines determine operating conditions of the converter, i.e., the primary speed and the ratio necessary to develop the secondary torque, and the converter's efficiency

been comparatively hesitant to introduce it. First, as already explained, it is not as easy to understand the characteristics of hydrodynamic drive as is the case with mechanical gears. Further, for motor drive it was necessary to develop special types of hydrodynamic gears. But today there is no doubt that, just as for mechanical gears, the quantity production of special types of hydrodynamic gears can be worked out. This will come when proper and sufficient experience with hydrodynamic transmission has been obtained.

Selecting Seals

By George Z. Griswold

ALTHOUGH the discussion last month in the first article of this series centered around unit seals, many facts relative to the specification and application of both seals and packings were cited. As pointed out, unit seals have characteristics—adaptability, compactness, predetermined friction load, accessibility and to a lesser extent standardization—which often make them the obvious choice for applications where these factors are demanded. But frequently it is found easier and more advisable to use packings in one of the many types available. This article will discuss some of the kinds of packings and the uses to which they can be put.

FELT: Pressed felt made entirely of wool fibers and of mixtures of wool with cotton or similar fibers has many uses as packing. One great advantage is its tendency to fit a shaft snugly without creating friction. It can be obtained in varied densities to take care of different oils and greases and can be applied easily without need of special designing. It is not subject to attack from oils and greases and does not pit stainless steel.

In any particular case the type of felt to be used should be considered from the standpoint of quality necessary, cross-sectional dimensions, and its assembly

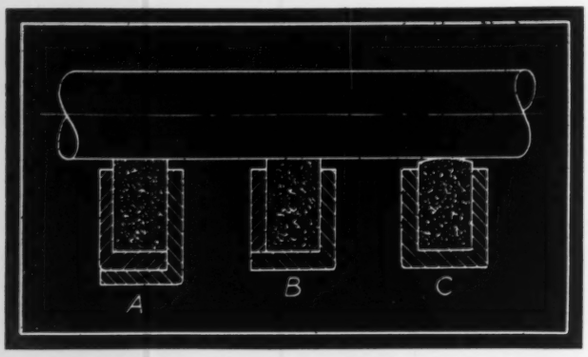

Fig. 1—Schematic diagram of three types of metal retainers for felt packing, bearing edges of A and B being straight, that of C slightly convex

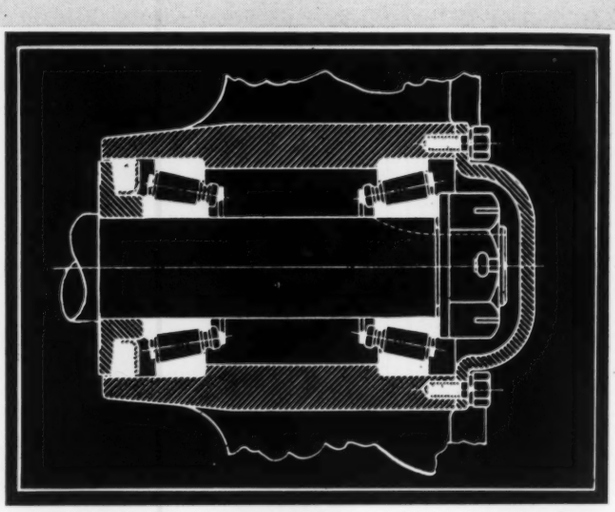

Fig. 2—Held in position by still another type of metal retainer, felt is used to protect roller bearings

into place. Felt can be used in S. A. E. 1, 2 and 3 densities for low and medium shaft speeds and in S. A. E. 6 and 7 at medium speeds for heavy oil and average grease sealing. Felt washers should fit into working position without appreciable distortion. When in place the felt should be so set that the working surface is even all around, with no eccentricity.

Felt is often made up with a light gage metal retainer which in some aspects resembles a unit seal. *Fig.* 1 shows schematically three types of retainers. In styles *A* and *B* the bearing or working edge of the felt is practically straight; in style *C* it tends to a convex curve, giving the felt slightly greater pressure on the shaft at the center. The felt is then "splayed" out somewhat against the shaft, with a good sealing effect. Where felt is assembled without a retainer, proper support should be given to it on both faces, as in *Fig.* 2. When felt is used in strip form, with ends bevelled, the bevel should be made with—not across or perpendicular to—the grain of the felt.

Combinations of felt and chloroprene compounds have been effective in increasing the oil-retaining properties of packings. The severity of the required service determines the layer makeup of the felt and

Seals and Packings

Part II—Packings

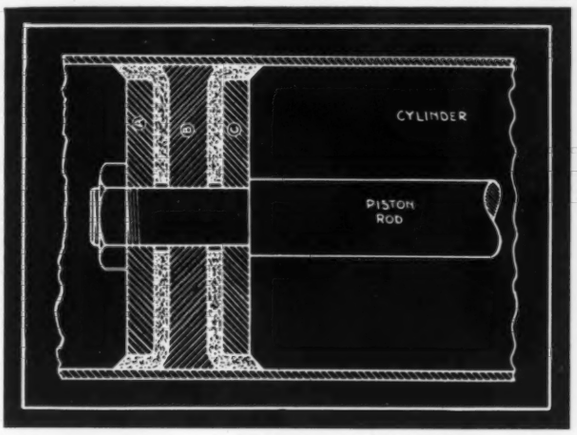

Fig. 3—Cup leather packing, where A and C are follower plates, B the piston proper. Fillets are desirable

synthetic combination. It may be said that for high-speed shafts only soft felt should be used, to prevent glazing and consequent scoring of the shaft. For highest protection against lubricant loss at slower speeds, the use of combination packing is indicated.

Another advantage of felt and chloroprene combinations is reduction of space. In one instance where the felt formerly used measured 4½ inches outside diameter, 3¾ inches inside diameter and 5/16-inch thick, a combination washer reduced the space to 4⅜ inches outside diameter, 3¾ inches inside diameter and 3/16-inch thickness. The combination consisted of felt 5/32-inch thick with a layer of neoprene 1/32-inch on one side.

LEATHER: Leather packings are made in many different forms and shapes, but the four most widely used are the cup, flange, U, and V or chevron types. *Fig.* 3 illustrates a cup packing, where *B* is a piston proper while *A* and *C* are follower or spreader plates. The so-called spreader plates may be made from thin stampings, shaped spring steel or some similar material to keep the sides of the cups against the cylinder wall. Fillets to back up the packing adequately at all points are desirable on the piston as well. This shape of packing is used largely for application to ends of plungers, valves and pistons. Specially processed, it may be used on carbon dioxide machines, sulphur bearing liquid machines, other fluid pumps, and on compressors of various kinds.

To seal against a shaft or rod, either revolving or reciprocating, in machinery operating under normal pressures, a flange type leather packing is often used, as illustrated in *Fig.* 4. The average hydraulic pump uses a flange packing, for instance. In addition to fillets to back up the packing it is desirable to provide a grooved recess as indicated in the diagram. This recess accommodates a ring of leather to exert pressure against the sides of the packing and keep it fitting snugly against the ram.

Two forms of U-type packing are shown in *Fig.* 5, the round bottom and square bottom types. U-shaped packing is a noncompression type with two sealing edges—an inside and an outside—which derives its effectiveness from the pressure within the U, forcing the lips or sides against the surface of a moving or reciprocating part and another fixed surface, not from drawing down on a packing nut. It is, therefore, especially desirable for higher working pressures. To

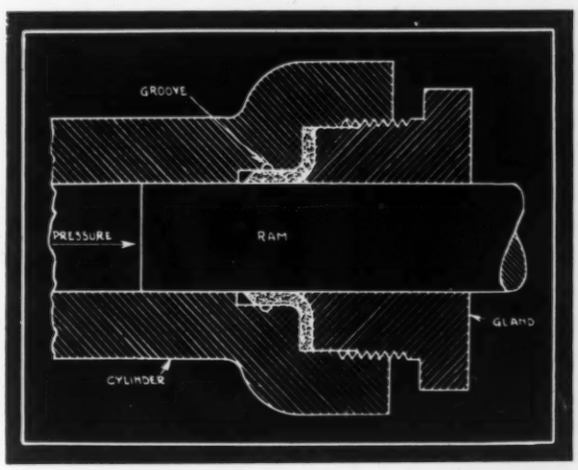

Fig. 4—A grooved recess is often provided in addition to fillets when flange leather packings are employed

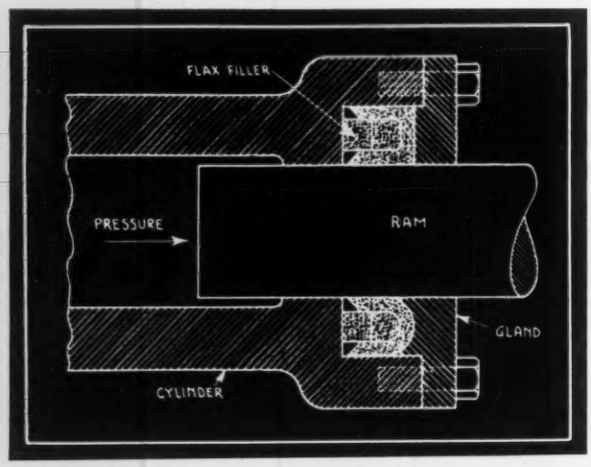

Fig. 5—Two forms of U-type leather packing are shown here, one with round bottom, the other square bottom

back up the packing properly the gland should have fillets as shown. A flax filler should also be used between the lips of the U and slightly higher than the inside height of the U. The flax fillers should be lubricated with a good oil and graphite solution, and where square flax is used the joints should be staggered.

Closely related to the U type, the V leather packing is particularly suitable for sealing where it is difficult to dismantle a piece of equipment to the extent necessary to slip a solid U packing over the end of the rod, and for extra long reciprocating motion. Correct design for a V packing is shown in *Fig.* 6, where ¼-inch has been allowed for take-up on the gland ring. Clearance between the gland ring and the plunger is .003-inch. Supporting rings for both top and bottom rings are usually recommended and should be

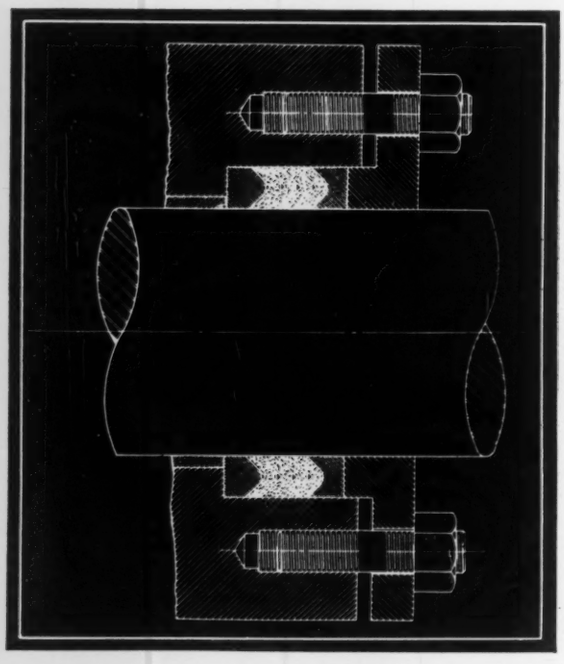

Fig. 6—Correct design for a V-leather packing, closely related to U type. Machining of supporting rings is important to maintain support

machined to the same included angle of the packing to maintain proper support and flexibility, as shown in the diagram. The ring fitting into the V section of the packing should be machined with a radius equal to the radius on the base of the packing, which is usually the thickness of the leather plus 1/64-inch.

Leather packings can be processed to withstand highly corrosive action, at pressures up to 10,000 pounds per square inch, and temperature up to 270 degrees Fahr. Less severe operating conditions make packings with less expensive processing satisfactory. Care should be exercised when installing a leather packing to keep its edge or lip in perfect condition, since it is the sealing contact. The packing should be handled so that the rounded portion or heel will make the first contact with the part of the machine which revolves or reciprocates. A funnel-shaped tool made

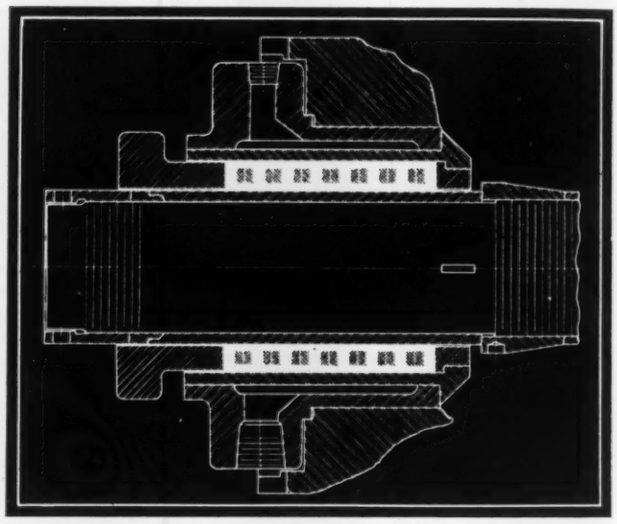

Fig. 7—Flexible metallic packing, made so that each ring is held in proper position for efficient sealing

from shim stock is sometimes used in easing the packing into place.

METALLIC: The combinations of materials making up packings are of course extremely numerous, including such ingredients as asbestos, rubber, duck, flax. Each has its special use, to be ascertained by consultation with the maker, and will not be treated at length here. But for a great number of packing duties on high pressure and high temperature pumping equipment, where peripheral speeds and pressure are unusually high, flexible metallic packing is frequently specified.

The purpose of the packing installation design in *Fig.* 7 is to keep all rings installed in a stuffing box seated so they will perform their proportionate share of service in relation to the position on the shaft or sleeve with all the rings installed. When a series of packing rings is used on a pump sleeve, for example, it is often discovered when they are inspected that only a few of the rings are carrying the sealing burden, despite the fact they may have been individually

(*Concluded on Page* 86)

Fig. 1—Below—Microstructure of a carbon steel as cast. Fig. 2—Right — Manganese molybdenum steel, as cast. (X125)

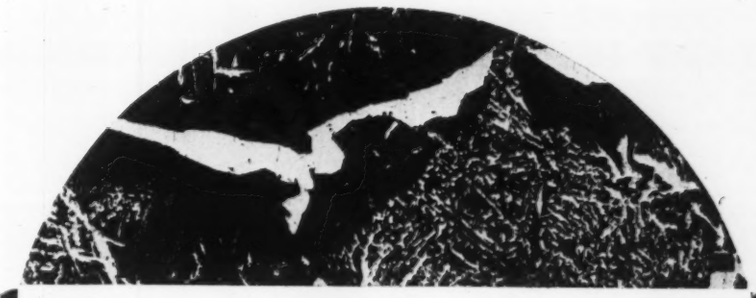

Fig. 3—Below—Microstructure of a carbon-manganese - molybdenum steel after being air quenched and drawn. (X125)

Metallurgical Aspects of Gearing

By Edward J. Wellauer
The Falk Corp.

EXPERIENCE indicates that less than five per cent of all industrial gear failures are caused by faulty material. Hence one of the most important duties of the designer and the gear metallurgist is to correlate the metallurgical phases of the design and manufacturing processes to obtain the optimum in gear performance. Materials must be selected to meet load and space requirements and they must also be capable of heat treatment and manufacture by the facilities available in the particular shop.

Steel is the most widely used gear material because it is capable of being processed to a great many different characteristics each of which has a definite use. For carburized gears the carbon content usually is within the range of .15 to .25 per cent. The lower carbons are used to secure maximum toughness, the higher carbons for maximum core strength. The trend in recent gear carburizing practice is for the use of carbon contents of .20 to .25 per cent which can be used with shallow cases obtained by gas carburizing or activated baths.

From a paper presented at the recent annual meeting of American Gear Manufacturers Assn.

Gears heat treated before machining have a .30 to .45 per cent carbon range if the steel is to be water quenched, a .40 to .60 per cent carbon content if the steel is to be air or oil quenched. Gears which are to be hardened after cutting have .45 to .55 per cent carbon. For all cases, the carbon should approach the upper limit as the size of section or desired hardness increases.

Alloys are added to gear steel to improve: (1) The durability of gear profiles to withstand contact and wear stresses, particularly those caused by dynamic influences; (2) the strength of gear teeth to withstand tooth breakage; and (3) both durability and strength. The profile or surface durability is dependent upon surface hardness, and alloys which provide or facilitate the heat treatment for maximum hardness (chromium, manganese and molybdenum) are specified when surface durability or high static strength is required. Maximum resistance to tooth breakage caused by shock or impact loadings is secured with such alloys as nickel, vanadium or molybdenum.

The capacity of a gear is dependent upon the degree

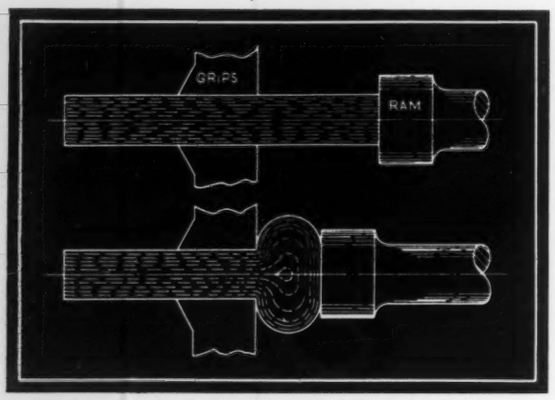

Fig. 4—Proper flow lines in a forging frequently can be obtained only by upsetting, as shown diagrammatically. Flow lines can be made radial

of the profile accuracy and finish. Therefore attention is given, particularly in gears cut after heat treatment, to such alloy additions as molybdenum, sulphur and lately lead which improve machinability and surface finish.

It is difficult to evaluate exactly the position of cast iron in the gear field because of the most recent developments in the technique of cast iron founding, alloying and heat treating which have not been fully tested under actual service conditions. Cast iron is not as versatile nor as flexible as steel in regard to the properties available by various heat treatments. The quality of cast iron is dependent to a very large degree upon the founding practice. Carbon content varies between 2.5 and 3.5 per cent. The additions of alloys have approximately the same effect as when added to steel. The usual application for cast iron is one of light unit loading, minimum shock, and low speeds and velocities.

The question of definitely specifying physical properties for gear steels is not answerable at the present time because of the impossibility of accurately determining the developed stresses. This is particularly true as regards bending stress calculations for the strength of gear teeth.

Profile Wear Is Function of Hardness

Experience and extensive testing have indicated that profile wear is a function of the brinell hardness. The trend of capacity versus hardness is well known for brinell values between 180 and 400. In the ordinary hardness ranges, the tensile strength has a fairly uniform relation to the brinell. For the general industrial gear which must be rated for surface resistance to wear and abrasion, it is more important to specify hardness than physicals assuming that the hardness is obtained by the best possible heat treating procedures.

The designer has a choice among the following available forms or sources of materials for gears: Rolled plate or bar stock, forgings or castings. Rolled bar stock is used because of its low cost and availability. The process of repeatedly passing the material through a pair of rollers until the proper size and shape has been produced results in marked directional properties. Round bar stock or rolled flats formed into circular rims have minimum properties in the direction where maximum loading in bending and shear occurs. This is not particularly detrimental for small sizes but it prevents the use of rolled bar stock for large size, heavily loaded pinions or gears.

A forged gear may be specified for one of the following reasons: First, the forging process can be used to shape a piece more closely to the finished dimensions; secondly, a forging can be used to refine the structure of the metal; thirdly, a forging can be used to shape the metal in a manner to take advantage of the resulting directional properties. It is sometimes possible to obtain all these results in one forging.

The maximum size of hammered forgings is limited by the capacity of the hammer and the shape of the piece. With sharp percussion blows there is a constant danger of rupturing the material. Therefore for all forgings upward of a few hundred pounds or where the sections are complicated, the metal is shaped by "pressing."

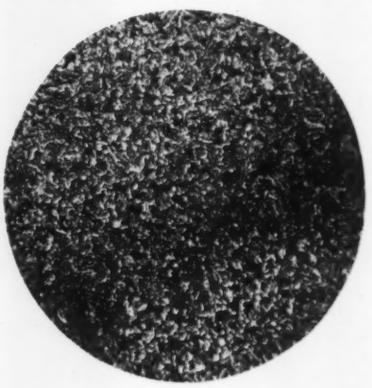

Fig. 5—Excellent refinement even in large sections is produced in a normalized alloy steel. (X100)

In many instances, the proper flow lines can only be secured by upsetting the material. For a bevel pinion the operation is completed as diagrammatically illustrated by *Fig.* 1. The flow lines or forging fibers can be made radial, thereby securing the maximum resistance to breakage. Limitation of the upsetting method is determined by the proportions of the large and small diameters. When the ratio is too high, sufficient material cannot be gathered for the upset and "tears," "ruptures" or other faults can occur.

Castings are very extensively used for both small and large gears and are universally accepted as the proper choice for all large diameters especially for the gear element. Steel gear castings have a .30 to .45 per cent carbon content. The usual alloy additions for the larger sizes consists of manganese (.90 to 1.50 per cent) with one of the following: Molybdenum (.15 to .40), nickel (.75 to 1.25) or vanadium (.10 to .20).

An important phase of gear casting manufacture is the thermal treatments used to prepare the steel for

service. These thermal treatments are used to refine the "as cast" structure and to relieve the casting strains. The "as cast" microstructure of a carbon steel is shown in *Fig.* 1, of a manganese molybdenum steel in *Fig.* 2. To refine the structure requires that the ferrite phase (white constituent) be dissolved to form a homogeneous structure. This is accomplished by a high temperature treatment, 1625-1750 degrees Fahr., followed by an air or furnace cool. The "air cool" or "normalizing" treatment is preferred because the rapid cooling rate prevents the ferrite from precipitating in its original form.

Low carbon cast steels which are not to be quenched are usually given only one high temperature treatment. Alloy steels are sometimes given another air quench from 1475 to 1550 degrees Fahr. (depending upon the size and composition) followed by a draw to bring the hardness within the proper range. The microstructure resulting from such a treatment applied to a .40 carbon, 1.25 manganese, .20 molybdenum steel is illustrated by *Fig.* 3.

Experience has proved that profile durability must be given more consideration than resistance to breakage. For the average industrial gear train, the heat treatment required to secure a proper durability capacity will provide from three to over six times greater strength capacity than necessary to carry the load.

Fundamentally, there are only two methods of obtaining physicals (specifically hardness) for increased durability of the contacting surface. These are surface hardening and full hardening. Surface or profile hardness is obtained by means of: (1) Carburized cases, (2) light or activated cases, (3) nitriding and (4) flame hardening.

In the carburizing process, care must be exercised to have a uniform, well diffused case and all indications

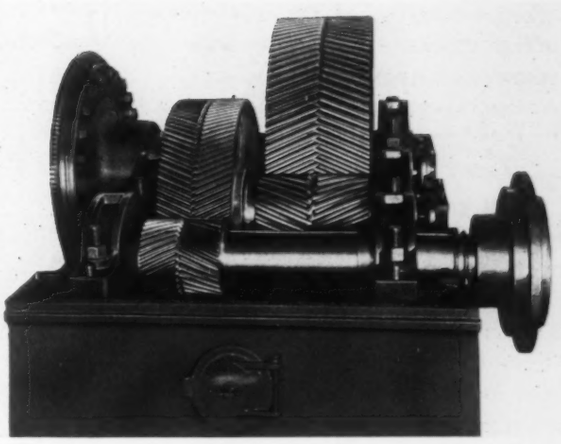

Fig. 6—This mill unit shows several examples of gears cut after heat treatment, including high speed and mill pinions and a low speed gear

of an excessive cementite network should be avoided. The gears may be either pot quenched or cooled, and single or double quenched depending upon the steel analysis and gear application. Regardless of the quenching procedure, the quenching temperature and medium must be selected to avoid the retention of too much austenite.

A thin case of .008 inch to .020 inch is sufficient in some applications to provide surface durability, particularly where high abrasion exists. The usual light case is obtained by means of an activated bath or special gas and is high in carbon and nitrogen. These cases are inclined to be brittle especially as the carbon content of the steel increases. The carbon usually ranges between .30 to .45 per cent carbon.

The nitrided case is high in nitrogen and produces the hardest possible case. Nitrided cases have been successfully used for aircraft gears, pump gears handling abrasive compounds, etc. Recent improvements in nitriding steels have eliminated some of the difficulties previously encountered. The process results in very low distortion but the special steel, long treating period and complicated equipment increases the cost.

Flame hardening is used when it is desired to surface harden gears of a size larger than can be economically handled in carburizing equipment or when the size or shape limits a full quench. The flame hardening process as practiced at present, however, inherently violates the following principles of good heat treatment: (1) Slow and uniform heating above the proper critical temperatures; (2) complete diffusion and solution obtained by a proper "soaking" period; (3) quenching at a rate which will

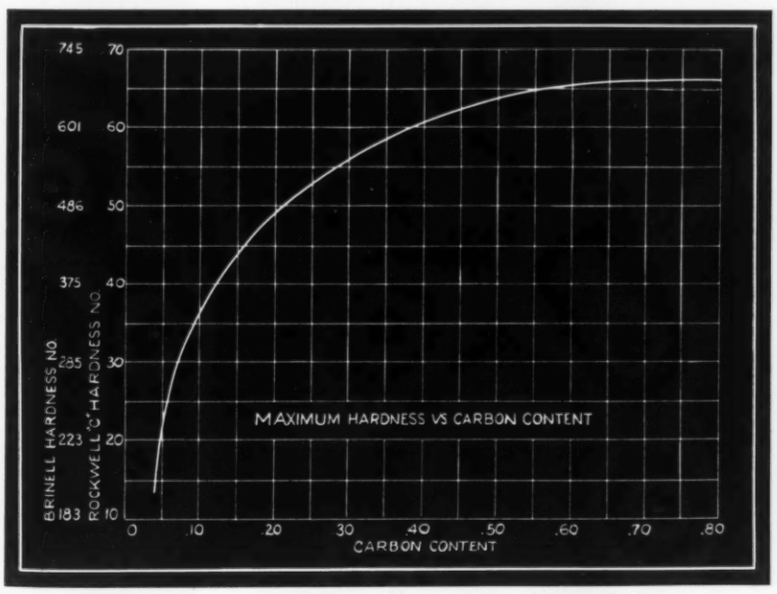

Fig. 7—Maximum hardness of gears depends only upon carbon content. Limit of durability capacity is shown

give transformation without quenching cracks or surface checks; (4) a proper tempering treatment to remove brittleness and to relieve internal quenching stresses. The process, because of the foregoing violations, is limited to applications which are inherently of the same order of quality.

Small gears in automotive, aircraft, machine tool, and small gear reducer applications are often heat treated after cutting. The advantage lies in securing hardnesses above the machinability range at low cost. These direct hardened gears have a .40 to .55 per cent carbon content with emphasis placed upon such hardening alloys as chromium and molybdenum with nickel or vanadium as toughening agents when required.

In the preponderance of commercial gears used for speed reducers, steel mill units, high speed turbine reduction sets, pump drives, open gear sets, etc., the load carrying capacity, smoothness of operation and noise level are primarily dependent upon the accuracy, precision and finish obtained. These requirements preclude any possibility of introducing errors by heat treating operations performed after cutting. Therefore, such gears are cut after heat treatment.

The carbon content for gears cut after heat treating lies between .30 to .60 per cent. The lower values are used for small sections or alloyed steels, the higher values for larger sections. For ordinary commercial pinions, the maximum hardness for economical machinability is about 320 brinell. Special steels with controlled sulphur, grain size, etc., are used for production machining with hardnesses of 320 to 400 brinell.

Whenever possible, the blanks are liquid quenched and tempered to secure the maximum refinement and physicals for a given hardness. With large or complicated sections in which liquid quenching is hazardous, normalizing or annealing is used. A normalized section should be specified below 290 brinell in hardness in order to maintain satisfactory ductility.

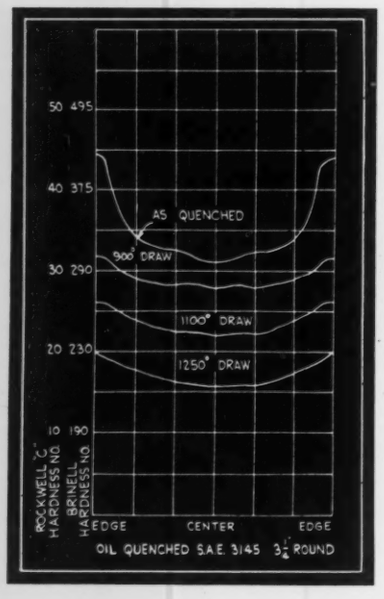

Fig. 8—Tempering of alloys tends to produce uniformity in degree of hardness through piece

Even in large sections (20 inches diameter and over) a normalized alloy steel produces excellent refinement, as illustrated by the photomicrograph *Fig.* 5. Hence the trend toward alloy steels for larger sections. The physicals of a large chrome-nickel-molybdenum normalized and drawn forging, a liquid quenched and drawn Cr-Ni-Moly forging and a double normalized and drawn manganese-molybdenum cast steel are shown in the following table.

Physical Properties of Gear Steels

	Cr-Ni-Moly Steel		Mn-Moly Cast Steel
	Normalized and drawn (lbs. sq. in.)	Liquid quenched and tempered (lbs. sq. in.)	Double normalized and drawn (lbs. sq. in.)
Yield point	85,000	105,000	56,000
Tensile strength.....	112,500	135,000	90,000
Elong., 2 in., per cent	23	20	27
Red. in area, per cent.	58	64	52
Brinell hardness	235–270	270–300	180–200

Typical examples of gears cut after heat treatment are illustrated by *Fig.* 6. The mill unit shown has a liquid quenched chrome-nickel-moly high speed pinion, an annealed manganese-moly cast steel low speed gear and normalized chrome-nickel-moly mill pinions.

The actual physical properties attained by metals are determined by the circumstances surrounding the application. Variables which are present and affect the properties of gear materials are: (1) Stress distribution (or stress concentration); (2) speed of load application; (3) impact; (4) temperature; (5) lubrication; and (6) surrounding atmosphere. For a thorough understanding of the principles of gear metallurgy it is necessary to study the effects of these variables upon the fundamental properties of materials, such as tensile properties, hardness, endurance, and impact.

Sharp fillets reduce the load-carrying capacity under tension. An increase in the velocity of stress application increases the tensile and yield values. For high velocities of application the tensile impact resistance remains practically constant until a certain "transition velocity" is reached, after which the tension impact resistance decreases rapidly.

Of interest to the designer is the fact that maximum hardness is dependent only upon the carbon content regardless of the alloys present. The relation is illustrated in *Fig.* 7 and probably indicates the limit of the durability capacity for gears.

The value of alloys such as chrome, manganese, etc., lies in their ability to produce deep hardening with less drastic quenches. At present, much attention is being given the "hardenability" of steels. Caution must be exercised in interpreting the values given for "as quenched" specimens because a tempering operation tends to produce rather uniform hardnesses as illustrated by *Fig.* 8. Interest is being displayed in the method of obtaining hardness by "sub-critical transformations" (Austempering) which might prove to be of substantial value in the gear field.

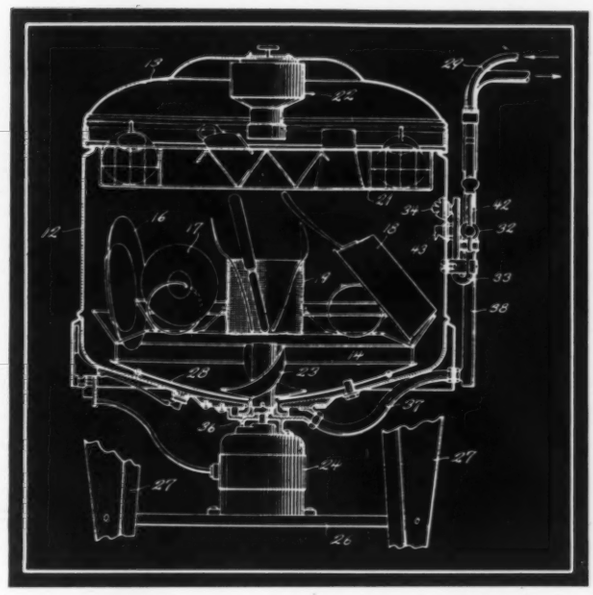

Fig. 1 — This dishwashing machine illustrates patentability of an operative machine structure

By George V. Woodling

How To Determine Patentability

ALTHOUGH an invention may appear to be new, there is always a possibility that the same general idea has been thought of before. This is especially true when the invention resides in a crowded field. It is remarkable how many devices are reborn generation after generation, which are not patentable.

The patent office constitutes the attorney for the public. Its duty is to prevent the granting of a patent to one inventor when a patent on the same idea already has been granted to another. However, the patent office, not infrequently, grants patents on ideas which subsequently are found by the courts to lack the requirements of patentability. When such patents are tested in a suit it is the duty of the court to declare them invalid. Therefore when a device is spoken of as being patentable it is understood to be one that is enforceable by the courts, and not one for which the patent office merely has granted a patent. Accordingly, a device may be "patented" but not "patentable."

For an idea to be patentable, it is not enough that the thing created shall be new and useful in the sense that its shape or form shall not have been known before. The gaging of a patentable invention is one of the most baffling tasks that attorneys, the patent office and the courts have to confront. The principal consideration is to make sure that the creation promotes the progress of science and the useful arts.

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Although statutes establish a yardstick for determining the requirements of patentability, the duty rests upon the courts to decide whether a given invention falls within the measure of the yardstick. The particular portions of the patent statutes relating to the question of patentability are found under Revised Statutes, Title LX, sections 4886, 4887, and 4929.

Bare reading of those sections of the statutes does not give a clear definition of what is meant by a patentable invention. Even courts, the patent office and attorneys do not agree on certain provisions. To present their meaning as clearly as possible, the outline chart on the following page has been developed. This outline reorganizes the provisions of the sections and divides them into three general categories embracing requirements which must be satisfied before an idea may be considered a patentable invention.

Consideration of patentability may be dropped immediately if it is found that an idea is disqualified as to any one of the three requirements. Referring to the chart the statutory requirements are:

I. STATUTORY CLASSES—The idea must fall within at least one of the statutory classes of patentable subject matter

II. UTILITY AND INVENTION—The idea must have utility and possess the dignity of invention

III. STATUTORY NEWNESS OR NOVELTY—The idea must avoid the factors affecting the

TEST OF PATENTABILITY—An idea in order to be patentable must satisfy three statutory requirements and the consideration of securing a patent may be dropped immediately if the idea is found to be disqualified as to any one of them.

I. STATUTORY CLASSES—The idea must fall within at least one of the statutory classes of patentable subject matter.

A. ART (PROCESS), SECTION 4886—The terms "art" or "process" may be defined as a connected series of steps or operations for accomplishing a physical result as opposed to accomplishing a mere abstraction.

B. MACHINE, SECTION 4886—The term "machine" is not a mere principle or idea, but a concrete thing consisting of parts. A machine differs from all other mechanical instruments in that its rule of action resides within itself.

C. COMPOSITION OF MATTER, SECTION 4886—A composition of matter results from the intermixture of two or more specific ingredients, and possessing properties different from, or in addition to those possessed by the several ingredients individually or in common.

D. ARTICLE OF MANUFACTURE, SECTION 4886—An article of manufacture is said to be distinguished from machines by not having any rule of action, and from compositions of matter by not involving the relationship of ingredients.

E. PLANT, SECTION 4886—A plant embraces any distinct and new variety of plant that is invented or discovered and asexually reproduced other than a tuber-propagated plant. Protection of plants includes trees of all kinds, shrubbery, flowers, budding, cutting and other methods of reproduction by the asexual method.

F. DESIGON FOR APPEARANCE OF ARTICLE, SECTION 4929—In design patents, it is the appearance which is protected rather than the structure.

II. UTILITY AND INVENTION—The ideas must have utility and possess the dignity of invention as distinguished from mere mechanical skill.

A. Invention tested by "negative" rules which specify what is not invention.

1. Mechanical skill is not invention.

2. Aggregation of parts is not invention.

3. Adding extra parts is not invention unless a new function results.

4. Duplication of parts is not invention unless a new function results therefrom.

5. Omission of parts is not invention, unless a new function results.

6. Variations in size is not invention unless a new function results.

7. Substitution of equivalents is not invention.

8. Substitution of superior for inferior materials is not invention, unless a new function results.

9. Excellence in workmanship is not invention.

10. The use of an old device for a new or analogous purpose is not invention, unless a new function results.

B. Test of utility.

1. The invention is useful if it is capable of accomplishing at least one of the objects claimed for it, though it may not accomplish all of them.

2. The objects of the machine must not be mischievous or immoral.

3. The utility necessary to amount to patentable utility should be gaged from a practical point of view.

III. STATUTORY NEWNESS OR NOVELTY—The idea must not lack statutory newness or novelty, and must avoid factors affecting the loss of right to a valid patent.

A. Anticipation may negative statutory newness.

1. UNPUBLISHED KNOWLEDGE—If an invention was known or used by others in this country prior to the conception date of the invention in question, then the inventor cannot obtain a valid patent on his invention.

2. PUBLISHED KNOWLEDGE—If an invention was shown or described in a patent or in a publication in this or any foreign country prior to the conception date of the invention in question, then the inventor cannot obtain a valid patent on his invention.

B. Delay in filing a patent application may negative statutory newness.

1. Statutory bars may negative statutory newness.

a. TWO YEAR PUBLICATION—If an invention was shown or described in a patent or in a publication in this or any foreign country more than two years prior to the filing date of the inventor's U. S. patent application, then he is barred from obtaining a valid patent on the invention.

b. TWO YEAR PUBLIC USE—If an invention was in public use or on sale in this country for more than two years prior to the filing date of the inventor's U. S. patent application, then he is barred from obtaining a valid patent on the invention.

c. PRIOR FOREIGN APPLICATION—If an inventor first filed a foreign patent application and subsequently filed a corresponding U. S. patent application more than 12 months after he filed in the foreign country, then he is barred from obtaining a valid U. S. patent unless his U. S. patent issues before the foreign patent.

2. Interference which awards priority to one party negatives statutory newness as to the other.

a. MUST BE FIRST INVENTOR—If an interference awards priority of an invention to another party, then the ideas of the losing party are not patentable to him since he is not the first inventor in the eyes of the law.

b. INTERFERENCE, WHEN DECLARED—An interference may be declared under two conditions.

(1) Between two or more pending applications claiming substantially the same patentable invention.

(2) Between one or more pending applications and one or more unexpired patents, claiming substantially the same patentable invention.

Requirements of patentability shown in outline form. All these conditions must be satisfied before invention is patentable

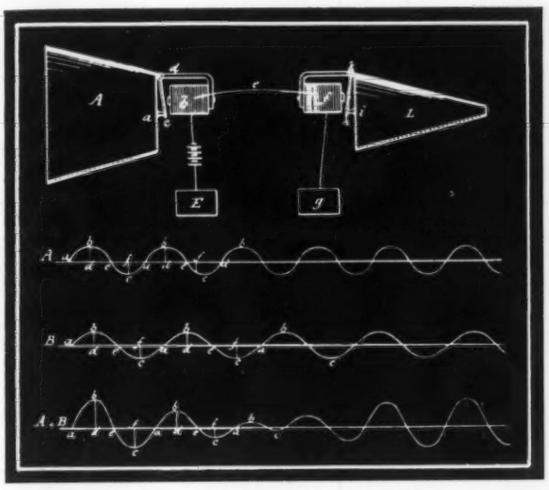


Fig. 2—Bell telephone patent is example of process with temporary physical result

loss of right to valid patent, and they must not lack statutory newness or novelty.

Therefore some things are not patentable because:

1. They do not fall under the statutory classes of patentable subject matter, even though they have utility and possess the dignity of invention, and even though they qualify as to statutory newness and novelty
2. They do not have utility and possess the dignity of invention even though they fall under the statutory classes of patentable subject matter and even though they qualify as to statutory newness and novelty
3. They do not qualify as to statutory newness or novelty even though they fall under the statutory classes of patentable subject matter, and even though they have utility and possess the dignity of invention.

Each of the three requirements will be further explained to give a detailed analysis of the breakdown shown in the chart of the three sections of the statutes.

Classes of Inventions

A process, to be patentable, must accomplish a physical result as opposed to a mere abstraction. Attempts have been made to obtain patents for a method of doing business' systems of accounting, and merchandising schemes upon the ground that they are patentable processes, but the courts have held that mere mental theories, ideas, or the methods of doing business are not patentable for the reason that they do not obtain physical results. The physical result need not be a permanent condition of the article or substance acted upon. It may be temporary, as, for example, where speech is transmitted by certain regulated undulations of the electric current in the telephone, similar to a claim in the Bell telephone patent, illustrated in *Fig.* 2, which reads:

> "The method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth."

Mixing certain substances together, heating a substance to certain temperatures, the treatment of materials to produce a given result, the performance of a series of acts upon a given subject matter which transforms it or reduces it to a different state or thing, are patentable processes. An article may be old and well known in the trade and yet it may be constructed by a new process which is patentable.

In a claim for a machine, the elements of the cooperatively associated parts are set forth as an operative structure, as for example the machine in *Fig.* 1 may be claimed as follows:

> "In a dish washing machine, a tub adapted to contain a supply of washing water, a rack for supporting dishes within the tub above the water level therein, an impeller in the tub for projecting water in the tub in contact with the dishes, an electric motor for driving said impeller, means for admitting water to the tub, and means for starting said motor in response to the admission of a predetermined amount of water, said last mentioned means including a movable member whose weight is increased by the admission thereinto of a part of said predetermined amount of water."

A composition of matter may be claimed in at least two ways. It may be claimed chemically or by its characteristic properties. A type of claim illustrating the latter may read:

> "A corrosion resistant copper-zinc alloy, which is workable in the cold state, containing copper in an amount of 30 to 45 per cent, at least one metal of the group cobalt and nickel in an amount of 3 to 12 per cent and in addition thereto manganese in an amount 4 to 15 per cent, the zinc constituting substantially the remainder."

Examples of articles of manufacture are tools or

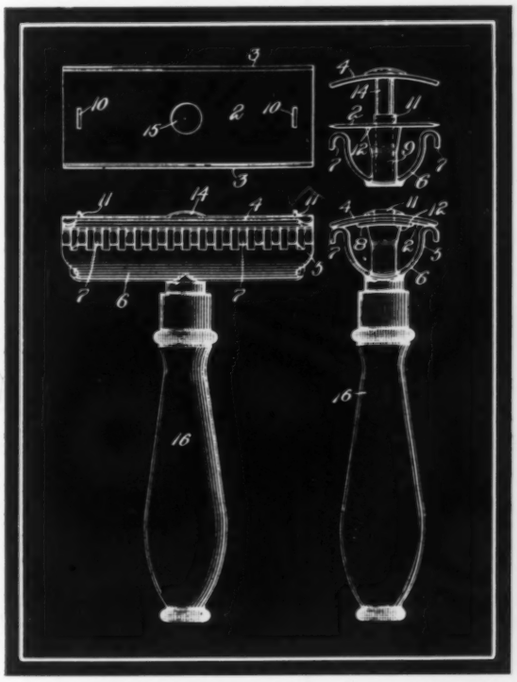


Fig. 3—Articles of manufacture are patentable. The razor shown in the drawing is an example

implements used by hand, a baseball mask, bat, or ball, a wheel, furniture, etc. An article claim for the blade of the Gillette safety razor, shown in *Fig.* 3, reads:

> "As a new article of manufacture, a flexible and detachable blade for Safety razors."

Design patents embrace any new, original and ornamental design for an article of manufacture, such for example, as the aircraft shown in *Fig.* 4.

Before leaving the discussion regarding the statutory classes of patentable subject matter, it is important to re-emphasize the desirability of asking oneself these questions when a problem of patentability arises: "Is the idea (A) a process, (B) a machine, (C) a composition of matter, (D) an article of manufacture, (E) a plant, (F) a design for appearance of an article?"

Negative Rules Determine Invention

Consideration of the second requirement for patentability, which calls for utility and dignity of invention is discussed next. Not all improvements possess the dignity of invention. Some of them do not rise above the level of the ordinary way of doing things, legally

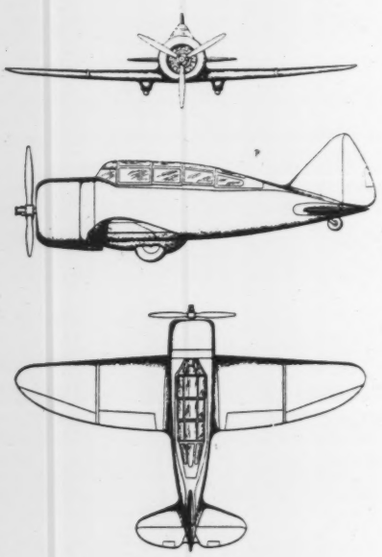


Fig. 4—Patent was obtained on airplane structure because design is both original and ornamental

called "mechanical skill," and are thereby not patentable. The line which separates invention from mechanical skill is a fine one. The difficulty of definition is made all the greater by reason of the fact that invention is determined by the ingenuity of the thing created. When several persons, working independently and confronted with the same problem, solve it in substantially the same way, there is evidence that invention is lacking.

The courts go no further in defining invention, than to establish certain "negative" rules which specify what is not invention. These negative rules operate by a process of exclusion. In addition to the negative rules set forth under division II-A of the outline chart the courts have pointed out others which may be considered as corollaries thereto. Those given in the chart are not exhaustive but are illustrative and serve to give the reader a general idea as to the requirement of the dignity of invention. An inventor should keep in mind constantly that all these rules give way if his device produces a new function. When he can argue convincingly that there is a new function, he stands a good chance of proving his idea is patentable.

Factors Affecting Novelty

An idea may fall within the classification of patentable subject matter and clearly possess the attribute of utility and invention, yet it may not possess the kind of novelty or newness demanded by statute. The chart shows two major sub-divisions, under division III, which may negative novelty or statutory newness, namely,

A. Anticipation may negative statutory newness of an idea

B. Delay in filing a patent application may negative statutory newness.

Under division B are two classifications:

1. Statutory bars may negative statutory newness

2. Interference which awards priority of invention to one party negatives statutory newness as to invention of the losing party.

The word "anticipation" so widely used in patent law may be given the following general definition: If two inventions are identical in subject matter, the prior anticipates the subsequent invention. Suppose an invention is made today and used publicly, and that tomorrow someone else invents the same thing. In this event the first invention is said to anticipate the second invention. Anticipation may be classified as: 1. Unpublished and 2. Published.

Unpublished anticipation includes those cases where the invention was known or used by others in this country, but where no public record was made prior to the conception date of the invention in question, as for example a mere public use of the invention. Published anticipation includes those cases where the invention was shown or described in a patent or in a publication in this or any foreign country prior to the conception date of the invention in question. A printed publication must be accessible to the public. The classification includes magazines, catalogs, or copies of patents, notwithstanding the fact that the patents may be void or might fail to claim the invention. Under statutory bars in the chart, three general divisions are given, namely,

a. The bar of two-year publication
b. The bar of two-year public use
c. The bar of prior foreign application.

The purpose of the statutory bars is to compel the

inventor to file his application promptly. If the inventor is dilatory in seeking protection the statutory bars are invoked, and the inventor loses his right to a valid patent. The bar of two-year publication is effective regardless of whether or not the publication was written by a stranger or by the inventor himself. Therefore, if it is desirable from the inventor's or the manufacturer's standpoint that his product be described in advertising leaflets or in trade journals for the purposes of broadening his market, a plan of procedure in the filing of applications should be formulated and carried out.

An interference proceeding, which awards priority of invention to another party, negatives statutory newness as to the invention of the losing party. In other words, the idea of the losing party is not patentable to him since he is not the first inventor in contemplation of law.

An interference is like a law suit, and never will be declared by the patent office where all the parties are patentees because the patent office has no jurisdiction to settle priority between two or more patents. There must be at least one pending application involved before the patent office has jurisdiction. The fact that one of the parties already has obtained a patent will not prevent an interference, for although the commissioner of patents has no power to cancel a patent he may grant another patent for the same device to a person who is entitled to such an award.

In studying the chart, it should be borne in mind that any or all of the divisions operate concurrently to exclude an idea from qualifying as patentable.

How Heat Treatment Affects Cast Iron

By G. A. Timmons, V. A. Crosby and A. J. Herzig
Climax Molybdenum Co.

MANY possibilities in the utilization of gray cast iron are opened up by modern methods of heat treatment. In the past little attention has been given to inherent differences in treatment between steel and cast iron. The response of the latter to heat treatment is of such practical importance that this subject has now become a significant part of the metallurgy of cast iron. Quenching and drawing effectively increase hardness and tensile strength. These improvements are obtained, however, at some sacrifice in shock resistance, transverse strength and deflection.

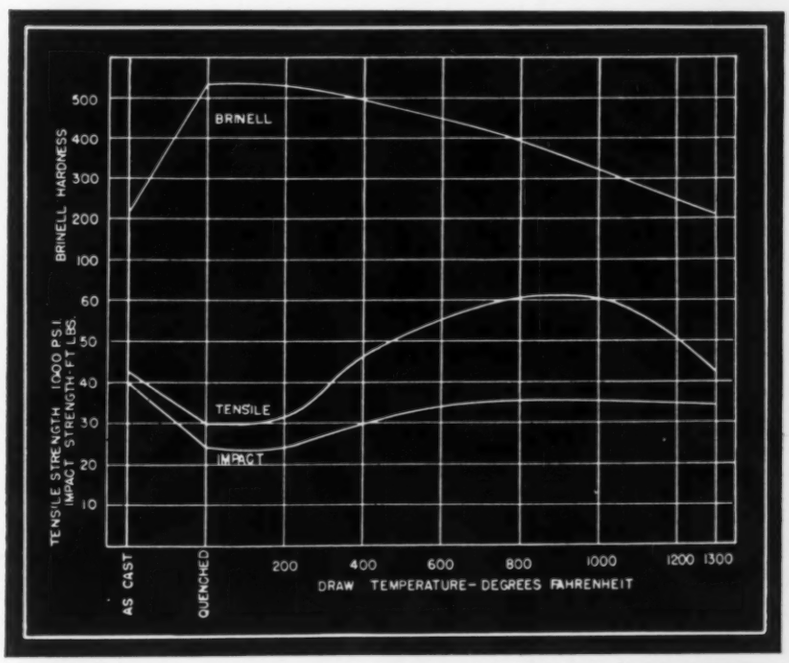


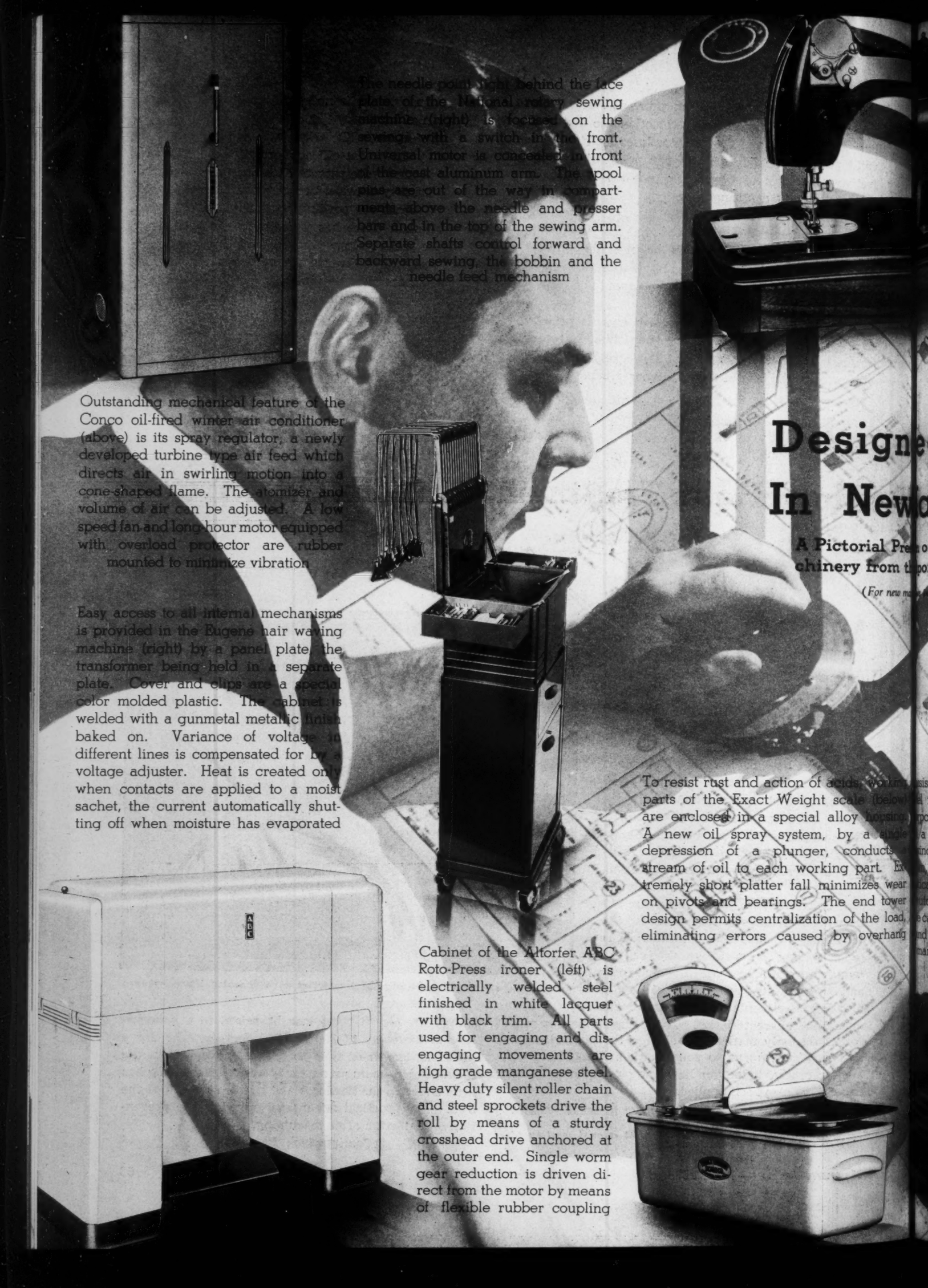
Fig. 1—Chart showing change in properties with drawing temperatures

Types of treatment most commonly practiced fall into three classes: (1) Drawing to relieve internal stresses; (2) annealing to decrease hardness; (3) rapid cooling from above the critical temperature to increase the hardness and strength, generally followed by a drawing treatment to modify the "as quenched" characteristics. These classes do not represent the only methods to change the properties of cast iron subsequent to solidification. Nitriding and, more recently, induction hardening and flame hardening have also been applied.

Drawing gray cast iron to relieve internal stresses simply implies that the iron be raised to a temperature in the order of 800 to 1200 degrees Fahr. for a sufficient length of time to permit movement in the casting for releasing stresses. Stress relief drawing has little effect on the hardness and tensile strength of the iron. The practical advantage gained is the prevention of distortion after machining.

(*Continued on Page* 88)

From a paper presented at the recent annual meeting of American Foundrymen's association.



The needle point right behind the face plate of the National rotary sewing machine (right) is focused on the sewings with a switch in the front. Universal motor is concealed in front of the cast aluminum arm. The spool pins are out of the way in compartments above the needle and presser bars and in the top of the sewing arm. Separate shafts control forward and backward sewing, the bobbin and the needle feed mechanism

Outstanding mechanical feature of the Conco oil-fired winter air conditioner (above) is its spray regulator, a newly developed turbine type air feed which directs air in swirling motion into a cone-shaped flame. The atomizer and volume of air can be adjusted. A low speed fan and long-hour motor equipped with overload protector are rubber mounted to minimize vibration

Easy access to all internal mechanisms is provided in the Eugene hair waving machine (right) by a panel plate, the transformer being held in a separate plate. Cover and clips are a special color molded plastic. The cabinet is welded with a gunmetal metallic finish baked on. Variance of voltage in different lines is compensated for by a voltage adjuster. Heat is created only when contacts are applied to a moist sachet, the current automatically shutting off when moisture has evaporated

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To resist rust and action of acids, working parts of the Exact Weight scale (below) are enclosed in a special alloy housing. A new oil spray system, by a single depression of a plunger, conducts a stream of oil to each working part. Extremely short platter fall minimizes wear on pivots and bearings. The end tower design permits centralization of the load, eliminating errors caused by overhang

Cabinet of the Altorfer ABC Roto-Press ironer (left) is electrically welded steel finished in white lacquer with black trim. All parts used for engaging and disengaging movements are high grade manganese steel. Heavy duty silent roller chain and steel sprockets drive the roll by means of a sturdy crosshead drive anchored at the outer end. Single worm gear reduction is driven direct from the motor by means of flexible rubber coupling

Except for keys, pedals, switches and a "wiggler" causing vibrato, the Hammond Novachord (right) has no moving parts. A bank of twelve standard vacuum tube oscillators supplies the original impulses from which all other notes are derived. With each note of the Novachord is associated a control tube determining the attack and decay of the note, these tubes receiving their signal from the oscillator. Action of the control tubes in turn is controlled by the electrical circuit connected to each key. Other switches control tone and volume

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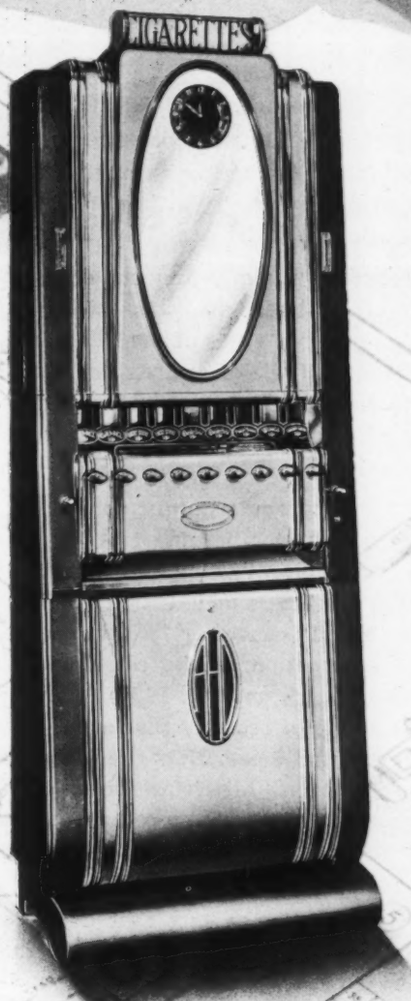
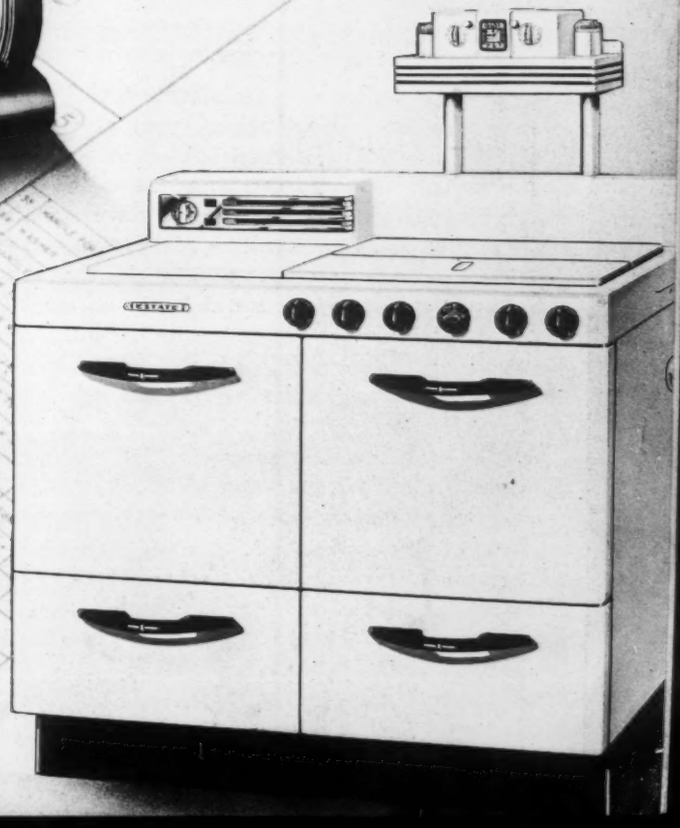


Shifting magazine of the DuGrenier cigaret vending machine (left) moves to the front for loading and has a capacity of 400 packages. The machine can be regulated to dispense free matches with each purchase or to sell matches after insertion of a coin. Change is given on odd-priced purchases. Provision is made to reject spurious coins

The Estate model 615 stove (below) has a combined oven gas cock and heat control, with a new T-shaped low temperature burner. Two-piece cooking top burners are either aluminum or monel. Mantel back is built in with lamp, interval timer and vent. Finish is white porcelain enamel



orking sis of the enclosed Silvertone rocket
below) l radio (below) is a 5-tube circuit,
using porating a 5-inch dynamic speaker
single a beam power type audio system.
cts ing is molded plastic, including the
. Ex n, and both front and back sides are
wear ical in appearance. Switch buttons
tower utomatic station selection are on top
load, e cabinet to prevent pushing the model
rhang nd a table. External drum type dial
manual tuning is unusual in design

Fluid Couplings and Torque Converters Have Promising Future

AGAIN the automobile industry deserves the plaudits of the machine design profession for furthering an engineering development that is of vital interest to designers. This time it is the device variously known as the fluid flywheel, hydraulic drive, and fluid coupling.

Automotive designers on many previous occasions have pointed the way to the application of methods, materials and parts that later have been adopted in the design of other types of machines. Among pertinent examples might be cited: Widespread use of antifriction bearings; adoption of streamlining which led to the current styling of machines; centralization of control; increased use of plastics and rubber; and employment of hydraulics as used in brake mechanisms.

Fluid couplings and hydraulic torque converters were first introduced in Germany, according to a paper presented at the recent S. A. E. meeting in New York and abstracted elsewhere in this issue. The fluid coupling has been used for many years by the Daimler Co. of England as standard equipment on its cars, and the torque converter likewise has been used by an English builder of trucks. Application of the coupling (described, incidentally, by MACHINE DESIGN as far back as Sept. 1930) has progressed gradually in this country, but it was not until recently that a major use was made of the device for automobile transmissions. Now the Chrysler Corp. has adopted this type of drive for some of its higher-priced models, and its employment by other automobile companies in the near future is foreseen. Whether the torque converter also will be utilized is a matter of conjecture at this time.

Indicative of the trend toward the application of the fluid coupling to various types of machines is the fact that drives of this nature are being tried out on oil-well equipment. If successful in this field another conquest can be added to the railroad, marine and automotive industries in which its advantages have already been proved. Exactly how far-reaching the effect will be remains to be seen. Designers cannot afford to overlook the tremendous possibilities that may develop, however, particularly if the drive becomes general in the automobile field.

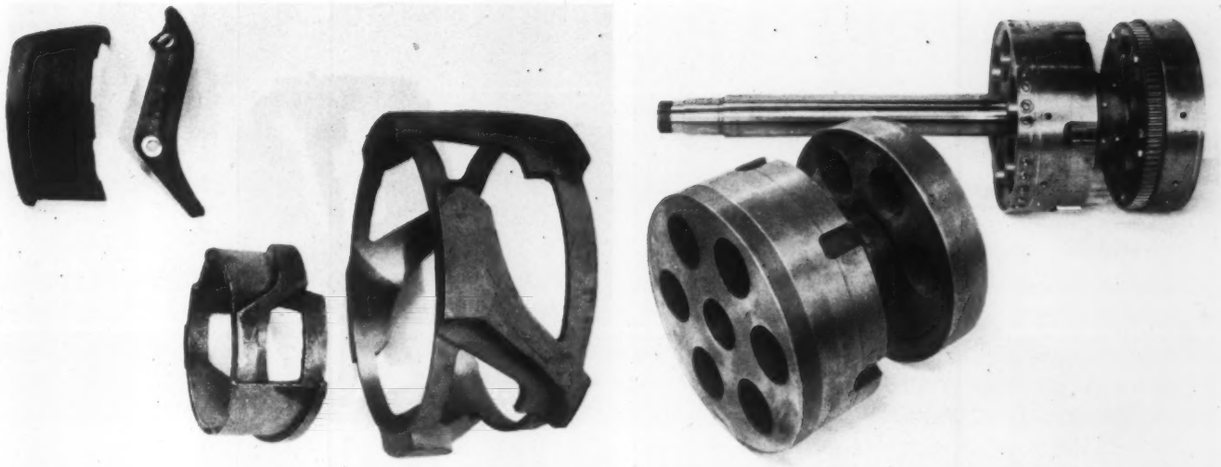


Fig. 1—Left—Rearrangement of patterns for cam castings from single cam type at upper left to castings containing two, four or six cams brought machining economies. Fig. 2—Casting for spindle carrier of automatic bar machine, and complete assembly after fabrication. Strength was doubled, strains obviated

Utilizing High Strength Castings

By J. L. Molner
National Acme Co.

METALLURGICAL progress and development of high duty cast irons, special steels and alloys of all types have been outstanding during recent years. As a result, designers of machinery have at their disposal metals with greatly increased quality and versatility. A recent experience of National Acme Co., Cleveland, in the redesign of some important cast parts in its Acme-Gridley automatic bar and chucking machines, illustrates the advantages accruing from careful selection of materials after study of physical and engineering properties.

Improved Service, Lower Costs Sought

Improved service qualities and reduced manufacturing costs were sought in redesign of cams, cam drums, spindle carriers and tool slide mounting plates. Cams such as those in *Fig.* 1 had previously been made as individual cam castings and were difficult to machine efficiently because of their odd shapes. A solution lay in changing the patterns of these cams so that two, four or six were included in a single cylindrical Meehanite casting, also in *Fig* 1. Machining set-ups were simplified and costs reduced about 300 per cent. Moreover, excellent physical properties, high Brinell hardness and high compression values with freedom from distortion caused by quenching, were attained by simple heat treatment (heat, quench, draw).

Increased speeds and feeds incorporated into the machine made extra strength necessary for spindle carriers and cam drums, shown in *Fig.* 2. Use of the same high duty iron more than doubled strength of the carriers. As cast, Brinell hardness was found to be low enough to provide improved machinability, with freedom from internal distorting stresses after machining. This last characteristic was important because the accuracy of work done on an automatic bar machine depends on the exactness of tool alignment maintained by the spindle carrier during service. Spindle spacing must remain set, but would be jeopardized by distortion of the material.

To increase wearing qualities and raise the tensile strength of the tool slide mounting plates to about 70,000 pounds per square inch, the Meehanite castings were simply quenched and drawn to a machinable hardness. These qualities are becoming increasingly necessary because of the severe sliding and heavy strains brought about by greater production speeds. In addition, the plates were freed from possibilities of shape distortion which might cause binding of the moving slide.

ASSETS *to a* BOOKCASE

Alloy Cast Iron

Published by the American Foundrymen's Assn., Chicago; available through MACHINE DESIGN *for* $3 *postpaid.*

Comprehensive and authoritative information on the uses and properties of alloy cast iron is contained in this flexibly bound 258-page book. Of particular note are the discussions of the effects of alloys and treatments on strength, machinability, hardness, corrosion resistance, magnetic and thermal properties. Chapters include metallurgical principles, effects of various alloys on physical and mechanical properties, methods of producing chill and effect of alloys on depth of hardness, heat treatment including annealing, grinding and tempering, hardening and hot quenching and foundry practice.

A large number of specific applications are given for the following general classifications: Automotive, chemical equipment, compressors and pumps, crushing and grinding equipment and abrasive-resistant castings, machine tools, metal-working dies, oil refinery equipment and railroad equipment. The information is presented in table form giving typical casting part, chemical range, metal section, weight range, brinell hardness, transverse and tensile strengths, and main requirements for application.

□ □ □

Theoretical Mechanics

By Carl Jenness Coe; published by the MacMillan Co., New York; available through MACHINE DESIGN*;* $5 *postpaid.*

A modern treatment of theoretical mechanics employing vector analysis, this book offers a comprehensive exposition of Lagrangian and Hamiltonian mechanics and presents a full discussion of displacements and motion of a rigid body. The author clearly expresses and proves basic principles in theorems.

After a brief introduction, rectiliniar motion is discussed. Vector algebra is introduced and applied to euclidian and analytic geometry. Vector functions of a scalar are employed to discuss curvilinear motion of a particle and the displacement and motion of a rigid body. Systems of sliding vectors form the basis of the treatment of statics of particles, of rigid bodies and of flexible cords.

Principles of virtual work are treated with respect to constraints imposed and equilibrium of the system. Chapters on kinetics of particles and rigid bodies follow and embody the use of linear vector functions. A chapter on the variational principles of mechanics introduces alternative sets of postulates on which mechanics may be founded and also a development of Lagrange's and Hamilton's equations.

□ □ □

Diesel Engines—Theory and Design

By Howard E. Degler; published by American Technical Society, Chicago; available through MACHINE DESIGN *for* $2.50 *postpaid.*

This practical book covers efficiency of internal-combustion engines, thermodynamics of internal-combustion cycles, fuels, combustion, testing, performance and design. The author discusses effective fuel injection and the advantages of spherical-shaped combustion chambers. He points out trends in design and the respective merits of 2-cycle and 4-cycle engines.

Problems of scavenging and superchanging are discussed together with those presented in convertible engine design. Calculation of stresses, heat conduction and efficiency with respect to the present tendency toward higher speeds and lighter weight engines are treated. Selection of materials, inertia and balancing, arrangements of crankshafts and firing order for 2 and 4-cycle engines, torsional vibration and critical speeds are also included.

□ □ □

Arc Welding

Published by the James F. Lincoln Arc Welding Foundation, Cleveland; available through MACHINE DESIGN *for* $1.50 *postpaid.*

Extensive in scope, *Arc Welding in Design, Manufacture and Construction* is a compilation of 109 papers which won Lincoln Foundation awards. Each study includes designs, calculations, procedures and illustrations useful to engineers and others interested in welding methods.

Containing 1408 pages and 695 illustrations, the book is arranged in ten sections discussing welding in the following fields: Automotive, aircraft, railroad, watercraft, structural, furniture and fixtures, commercial welding containers, machinery, jigs and fixtures.

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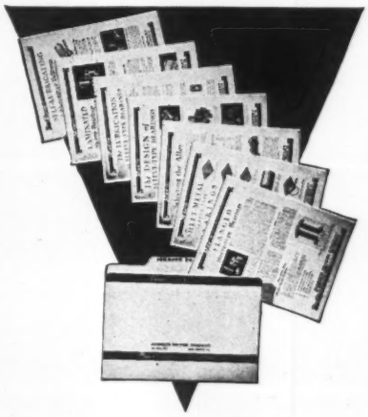

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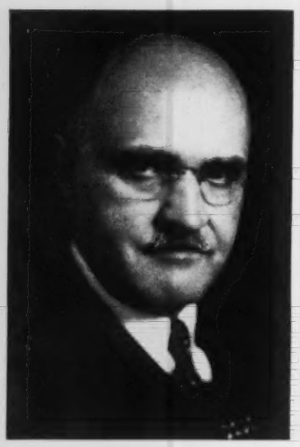


F. G. SCHRANZ

THIRTY-FOUR years in the engineering and sales of hydraulic and special machinery particularly qualifies F. G. Schranz for his recent appointment as general manager of Baldwin-Southwark Corp., Philadelphia.

Mr. Schranz received his technical training in Vienna where he graduated as a mechanical and electrical engineer. He also completed an apprenticeship as machinist. In 1905 he joined the Midvale Co. as machinist and a year later became associated with the Camden Iron Works of R. D. Wood & Co. as designing engineer. Among other capacities in which Mr. Schranz has served since joining the Baldwin-Southwark Corp. in 1915 is that of vice president in charge of sales and engineering. In 1929 when the company became the Southwark division of Baldwin Locomotive Works he was made manager of that division.

WALTER GEIST

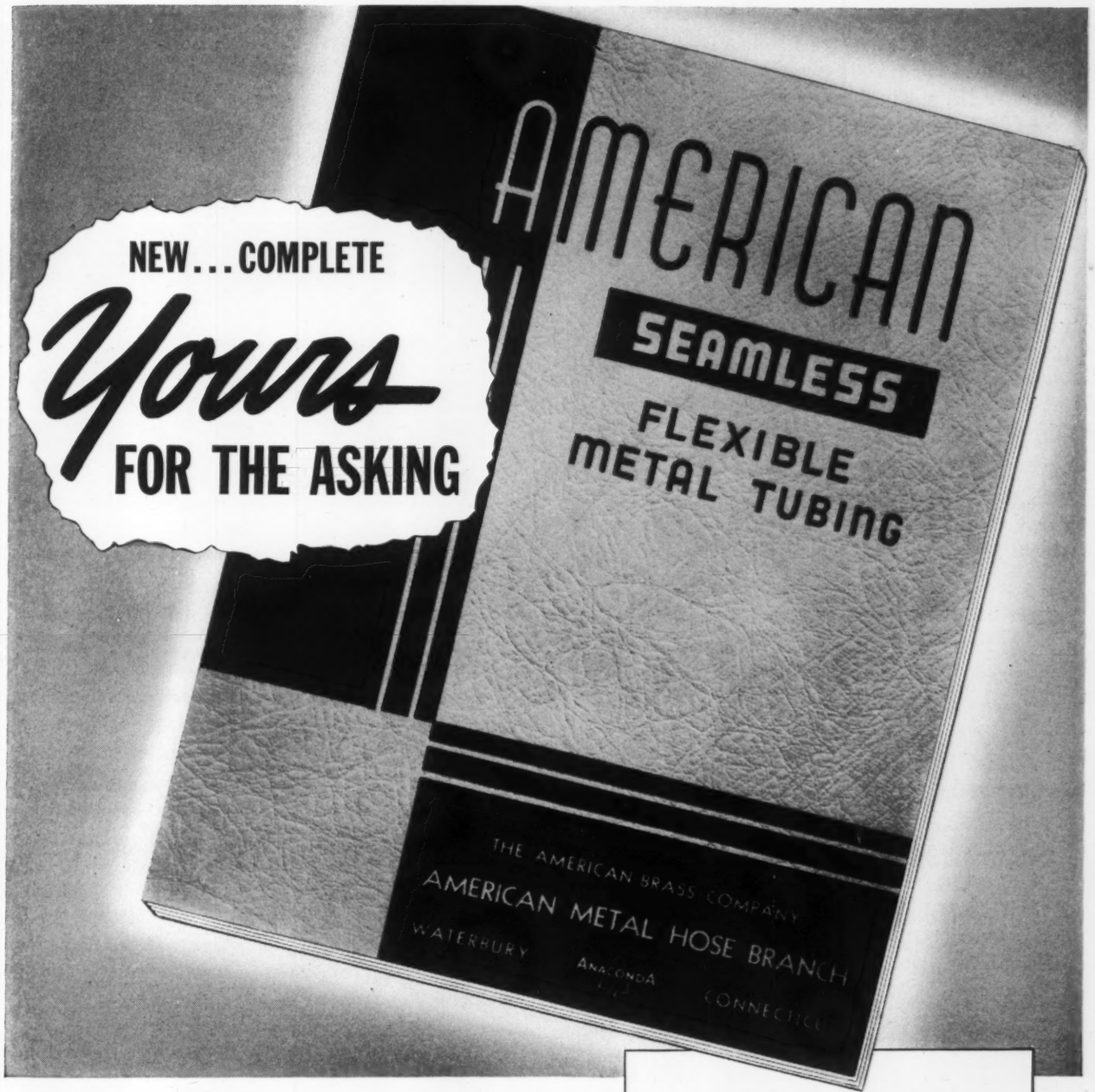
FROM errand boy in the saw mill engineering department to vice president of Allis-Chalmers Mfg. Co., during the period from 1909 to 1939, summarizes the career of Walter Geist.

After beginning in his lowly position with the company he advanced to that of draftsman, and progressed rapidly through various other positions and departments of the company, thus gaining knowledge and experience. In the flour mill machinery department, he became interested in design with particular reference to power transmission. As a result he originated the idea of the multiple V-belt drive principle which he first developed from an engineering standpoint and later from the merchandizing angle. In 1928 he was made assistant manager of the milling machinery department, and five years later was appointed general representative covering all district branches of the company.

A. W. SCARRATT

HAVING devoted himself strictly to engineering from the moment he entered high school until his present appointment, A. W. Scarratt is in an excellent position to fill his new post as vice president in charge of engineering and patents of International Harvester Co., Chicago.

A native of Minnesota, Mr. Scarratt received his education at the Mechanical Arts Technical high school, St. Paul, and later through special engineering courses at the University of Minnesota. From 1905 to 1913 he was employed in the mechanical, power and electrical departments of the Twin City Rapid Transit Co., successively as draftsman, designer and engineer. Entering automotive engineering he chose the position of designer, later becoming tractor engineer and finally chief engineer of the mechanical division of Minneapolis Steel & Machinery Co. By 1926 his experience



IT'S THE NEW American *Seamless* Flexible Metal Tubing catalog. There are 24 pages and over seventy-five illustrations in this latest manual which we believe is the most comprehensive analysis ever published on the subject of seamless flexible metal tubing.

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American Metal Hose

ANACONDA
from mine to consumer

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn. • Subsidiary of Anaconda Copper Mining Company
In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

led to his connection as assistant chief engineer and later chief engineer of Hyatt Roller Bearing Co. He became associated subsequently with International Harvester Co. as chief engineer of motor trucks and coaches. His progress with the company was rapid—in 1935 being promoted to chief of automotive engineering, a year later to assistant to vice president of engineering and finally to his present position as vice president in charge of engineering and patents.

♦

K. J. T. EKBLAW, agricultural engineer for the American Zinc institute and vice president of Western Advertising Agency Inc., has been elected to the presidency of the American Society of Agricultural Engineers.

♦

CORTICE H. HALL, associated with Fairbanks-Morse & Co. for the past three years as assistant chief engineer, has been named chief engineer in charge of development and design.

♦

MARVIN W. SMITH, previously manager of engineering, has been elected vice president in charge of engineering of the Westinghouse Electric & Mfg. Co.

♦

NATHAN SCHNOLL, formerly chief engineer of Solar Mfg. Corp., has been appointed president and chief engineer of Industrial Instruments Inc., Bayonne, N. J.

♦

WILLIAM PARRISH of the engine division of International Harvester Co., has been re-elected president of the Manufacturers' Division of the American Road Builders' association. H. N. Schramm, president of Schramm Inc., was re-elected vice president.

♦

HARRY G. THODE has joined the research department of the United States Rubber Co., Passaic, N. J.

♦

H. Y. BASSETT has joined the staff of Wolverine Tube Co., Detroit, as research engineer. Mr. Bassett has had considerable experience in the materials field.

♦

H. W. SCHNETZKY has become associated with Murphy-Diesel Co., Milwaukee. He was formerly president of the Wisconsin Motor Co.

♦

RALPH K. SUPER has been appointed to the brake engineering staff of Timken-Detroit Axle Co., Detroit. Mr. Super formerly was associated with Linderman Devices Inc. as chief engineer. Previously he was connected with Mack Truck and General Motors in engineering and research work.

♦

WALDEMAR P. RUEMMLER, St. Louis, has been awarded the eleventh Weston Fellowship by the Electrochemical society. He will continue his research work at Columbia university.

♦

HARRY GLAENZER will be relieved of his duties as vice president in charge of engineering for the Baldwin Locomotive Works in connection with active management of the company's Eddystone, Pa., engineering office. He will devote his time and efforts to developments in the railway motive power field. RALPH P. JOHNSON will be in charge as chief engineer at Eddystone, with CHARLES F. KRAUSS and E. J. HARTLEY as assistant chief engineers.

♦

T. E. BARLOW has been appointed metallurgical engineer of the Copper Iron and Steel Development association, the association of copper producers. Mr. Barlow has been a research engineer since 1936 at Battelle Memorial institute, most of his work being centered on the use of copper in cast iron, malleable iron and steel.

♦

DR. KATHARINE BLODGETT, an outstanding woman scientist, has been awarded the honorary degree of Doctor of Science by Elmira college. Her most recent discovery is that of a film coating that removes glare from reflected light on glass surfaces.

♦

DR. PAUL LESLIE HOOVER of Rutgers university has recently been appointed professor of electrical engineering and head of that department at Case School of Applied Science. He replaces PROF. HENRY B. DATES who will retire with the title of Professor Emeritus. Dr. Hoover received his bachelor of science degree at Carnegie Institute of Technology and his master of science at Harvard. After advanced studies at universities of Vienna and Paris he again returned to Harvard for an additional three years as research fellow. In 1927 he was appointed associate professor of electrical engineering at Case, continuing in this post until 1930 when he joined Rutgers as assistant director of the engineering experiment station. Four years later he was promoted to director with the rank of professor.

♦

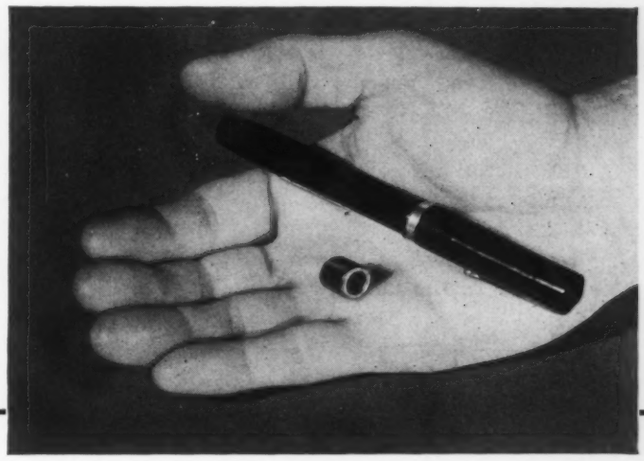
DR. ZAY JEFFRIES has been elected to membership in the National Academy of Sciences, which limits its membership to 350 and is recognized as the highest scientific rank an American can receive. Dr. Jeffries has contributed numerous important developments to the science of metals as a result of his research.

♦

HENRY S. WASHBURN, since 1921 president and treasurer of Plainville Casting Co., Plainville, Conn., has been elected president of the American Foundrymen's association. Having served as a director and vice president of the association, he is well fitted to lead the organization.

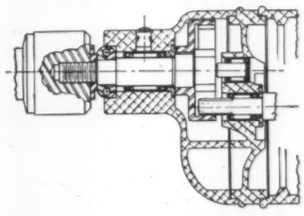
WHEN SPACE IS AT A PREMIUM

use the TORRINGTON Needle Bearing



Do space limitations in the design of your products seem to demand the use of plain bushings? Then you can frequently secure the advantages of anti-friction construction by changing over to the Torrington Needle Bearing.

Because of its simple design and its small diameter, the Needle Bearing can often be substituted for a plain bushing without requiring additional space. Consider, for example, the portable drill illustrated—a typical application where space is at a premium. See how easily three Needle Bearings were incorporated in the design. In most cases the Needle Bearing can be mounted in your present housings; a change in the size of housing bore is the only design modification needed to accommodate the bearing.



The Torrington Needle Bearing in a portable drill — A typical instance of its use in a limited space

Change is Inexpensive

You will find the change-over to anti-friction construction surprisingly inexpensive. The Needle Bearing is lower in unit cost than other types of anti-friction bearings, and its installation involves little labor expense. Built as a single compact unit, with the rollers permanently assembled in a hardened retaining shell, the bearing is readily pressed into position in the housing bore.

Your customers will appreciate the greater efficiency of the Needle Bearing, and the small amount of service attention it requires. Lubrication is efficient and thorough. The retaining shell, provided with turned-in lips, forms a reservoir for grease or oil, and the rotation of the needles constantly supplies lubricant to the rotating shaft.

The Needle Bearing is ideally suited for severe service in high-speed application. Its full complement of rollers provides many linear inches of contact, with consequent high radial load capacity.

If you are using plain bushings because of space limitations, investigate the possibilities of this small anti-friction bearing. The Torrington Engineering Department will assist you in laying out applications.

For further information, write for Catalog No. 9. For Needle Bearings to be used in heavier service, request Booklet No. 103X from our associate, Bantam Bearings Corporation, South Bend, Ind.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Makers of Ball and Needle Bearings
Branch Offices in all Principal Cities

TORRINGTON NEEDLE BEARING

NOTEWORTHY PATENTS

Fluid Power Unit Is Simplified

CONSTRUCTION features for variable fluid power rotary units of the "Waterbury" type have been simplified with respect to mounting elements and casing resulting in more economical production and lighter weight. In the unit shown in *Fig.* 1 the

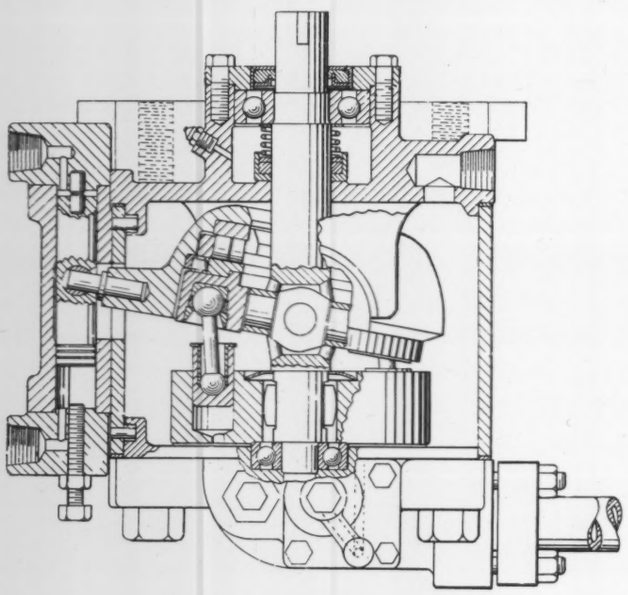


Fig. 1—*New fluid power unit with variable stroke facilities construction problems*

casing is composed of three members, two opposing faceplates and an intermediate ring made of standard tubing or pipe. All the machined surfaces for locating the working parts are on the faceplates. Control for varying displacement of the unit is mounted on the outer cylindrical surface of the tubular member.

As in earlier transmissions, the casing and working circuit are filled with fluid. Shaft is rotated at constant speed. As it turns, cylindrical barrel containing pistons rotates through universal joint together with the ring in a tilt box containing ball joints and connecting rods. In the position shown, the tilt box is in its extreme position for maximum displacement. The pistons are thus reciprocated within the barrel drawing fluid into the cylinder on one side and expelling it at the other through suitable valves located in the bottom plate.

Piston stroke may be varied by changing position of the tilting box. The control box shown at the left is connected to valves and source of pressure fluid for admitting pressure to either end. Thus when pressure is admitted at the top valve, a piston is moved downward reducing the stroke of the piston as desired. Likewise, when fluid is admitted at the other end the piston moves upward, increasing the eccentricity of the tilt box and bringing the stroke again to its maximum. Suitable bearings, packings and gaskets are provided as shown.

Features of this adjustable displacement fluid power transmission unit are covered by patent 2,146,117 invented by Henry G. Gros. The patent is assigned to the Waterbury Tool Co., Waterbury Conn.

Time Switch Stores Energy

GRADUALLY storing energy for switching operations to produce fast and powerful action at the desired instant, a newly designed time switch employs relatively light parts and reduces the load on the motor. Covered by patent 2,146,562 and assigned to General Electric Co. by Donald G. Cameron and George W. Sprenger, the switch provides a positive indexing system for operation at a predetermined

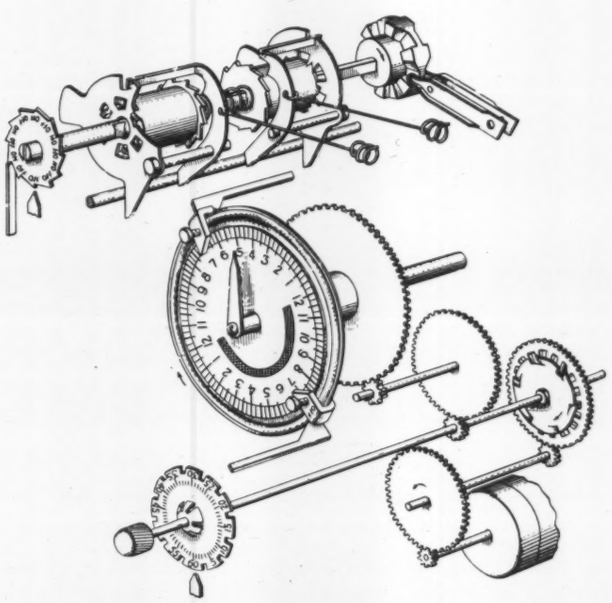
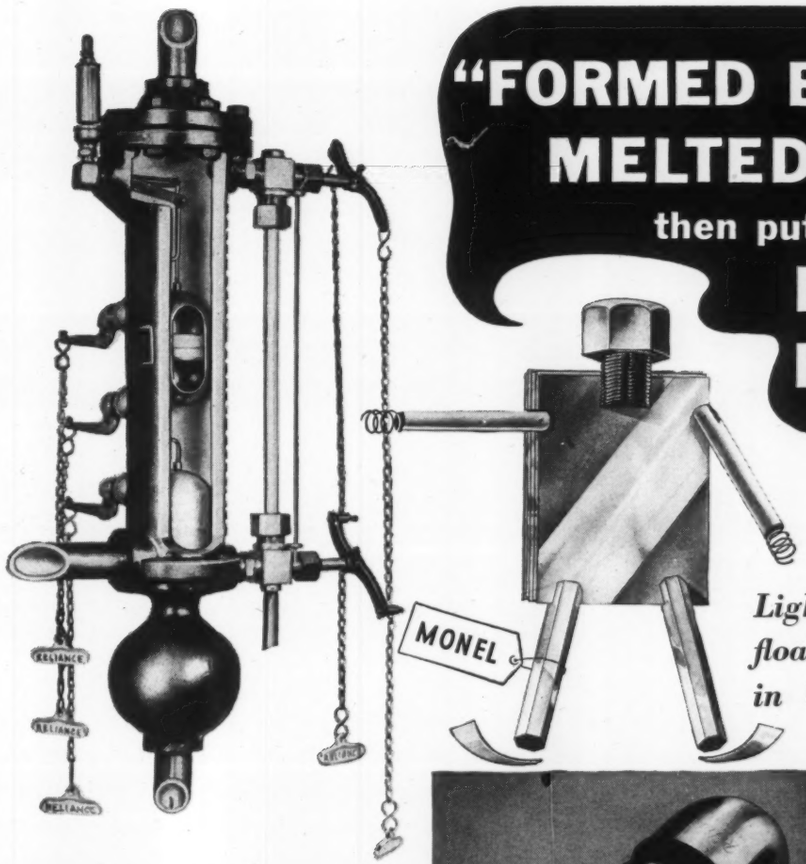


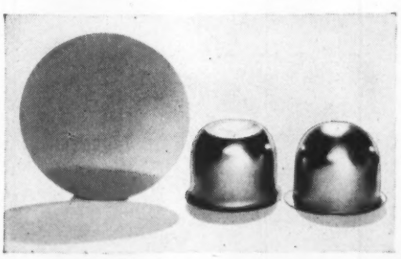
Fig. 2—*Cam and trigger mechanism operate switch forcefully and quickly with stored-up energy*

"FORMED BY PRESSES... MELTED BY TORCH... then put to work under HIGH STEAM PRESSURE!"

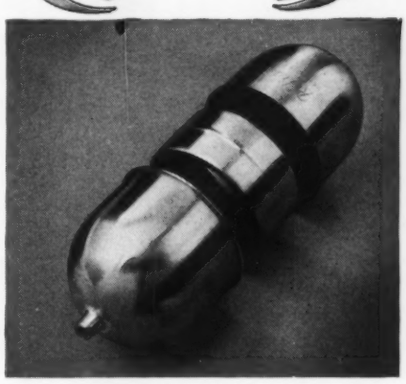


Light gauge welded Monel used for floats withstands severe conditions in both fabrication and service

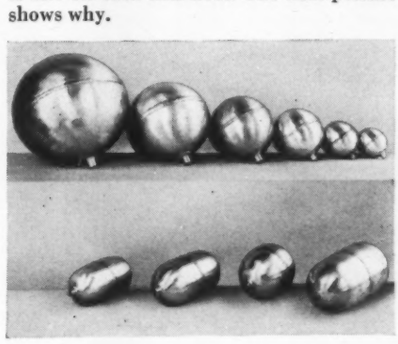
1. If ever a metal had to be *tough and strong,* it's the one used for floats in this Reliance gauge column. These floats must be light in weight to assure sensitive action and quick response to the slightest change in water level. Yet they are subjected to full boiler pressures up to 900 lbs. What metal is used? Monel . . . the metal that's rust proof and highly resistant to corrosion yet stronger and tougher than mild steel. Now see what this light gauge Monel withstands in *fabrication:*



2. Two drawing operations, with a stress relief anneal, are employed in forming the half-floats. Monel is ductile, as well as strong and tough, so it's a sweet metal to form, as this picture shows.



3. Here are two of the Monel half-floats ready for assembly on a steel reinforcing ring. The spud on the lower half is attached by silver brazing. Note that a slight flange is left on each half-float. The next picture shows why.



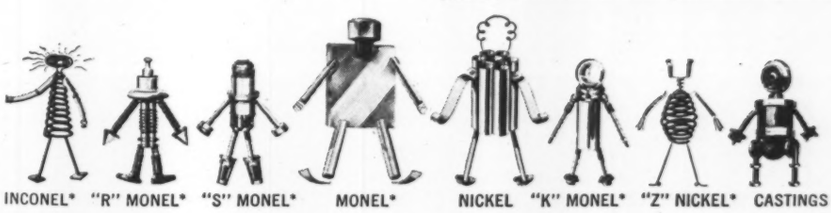
4. Semi-automatic welding on a specially built lathe is employed in making the floats. No filler rod is used. Instead, the lip on each half is melted down to form a strong, sound weld. Excellent welding qualities are another useful characteristic of Monel.

5. *(Left)* Welded light weight floats as used in Reliance safety water columns. All are guaranteed by Reliance Gauge Column Co. against failure due to corrosion, heat, high pressure or any other cause. Monel helps to make such a guarantee possible.

• • •

In your search for metals for difficult applications remember INCO Nickel and Nickel-copper alloys. Their unusual combinations of useful properties can get you out of many a tough spot. Which to use? INCO engineers and technical literature are both at your service. Call on them today. Address:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York, N. Y.



"Monel" and other trade-marks which have an asterisk associated with them are trade-marks of The International Nickel Company, Inc.

time. *Fig.* 2 illustrates the main features diagrammatically.

Power is supplied by a small synchronous motor of the type used in clocks. Clutches are arranged as shown for accurate setting of the switching mechanism. Adjustable switch-operating riders are clamped on the hour dial. Separate riders are provided for "on" and "off" operations to prevent any sequence reversal which might be obtained as a result of manual operation. Any number of riders for various sequences may be used.

Energy for operating contacts is provided by stressing springs and cocking the trigger and ratchet mechanisms shown. When the finger of the "off" rider engages the nose of its trigger, the latter is gradually rotated against the force of its spring. Ratchet teeth on the drum drop into slots as the trigger continues to rotate to a predetermined angle. At that point the finger rides off the end of the nose and trips. Momentum imparted rotates the shaft sufficiently to force the contacts to "off" position by means of a cam. Mechanism is accurately indexed and spring draws pawl from ratchet teeth ready for subsequent operation. In a similar manner the "on" rider operates the cam to close the contacts.

Because the energy of operation is stored and not a direct load on the motor it is possible to operate a number of contacts simultaneously. The leading edges of operating cam are tapered to provide wedging action sufficient to separate frozen or welded contacts. The operating cam is free to move axially to align itself with the switch blades. Switches may be equipped with omitting devices (not shown) for suspending operations for certain periods, with astronomical dials, or other combinations of features.

Gage Has Mercury Switch

SIZING gages for controlling machines or for limit indicators which are automatic in operation have recently been patented by Harry Allsop Dugeon. Assigned to Norton Co. and covered by patent 2,150,674, these gages employ flexible diaphragms and mercury with compensation features for temperature variations.

Two independent diaphragm chambers, one on each side of the unit, are illustrated in *Fig.* 3 and shown in cross section in the insert. Each is connected to a separate tube in which the mercury is free to rise and fall. Set screws at the sides of the diaphragms adjust the height of the mercury columns. On one diaphragm a contact point touches the surface of the work to be measured. Movement of this point varies the height of the mercury in the column at the right which serves as a mercury switch.

Separately adjustable terminals extend into this tube to complete independent circuits as the mercury reaches them. They may be used to initiate or stop machine functions or to control indicating devices such as for limit gages. When pressure is applied to the contact point by the surface of the work being ground or measured, mercury in the diaphragm recess is

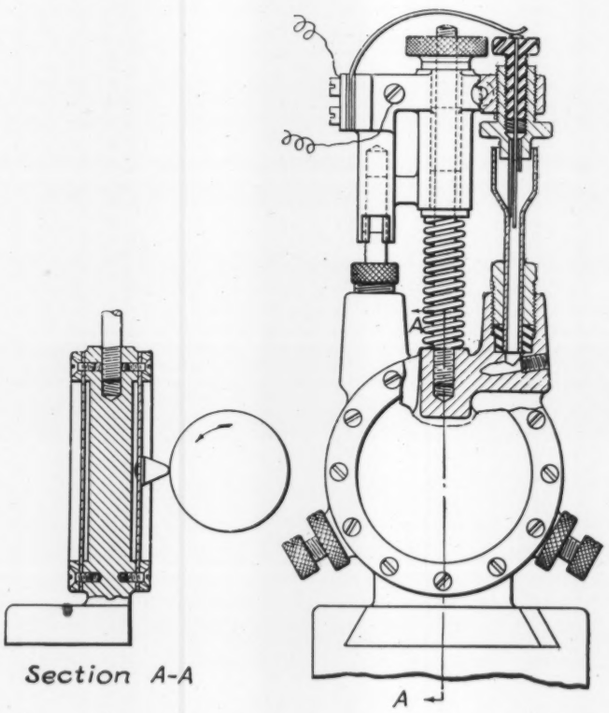
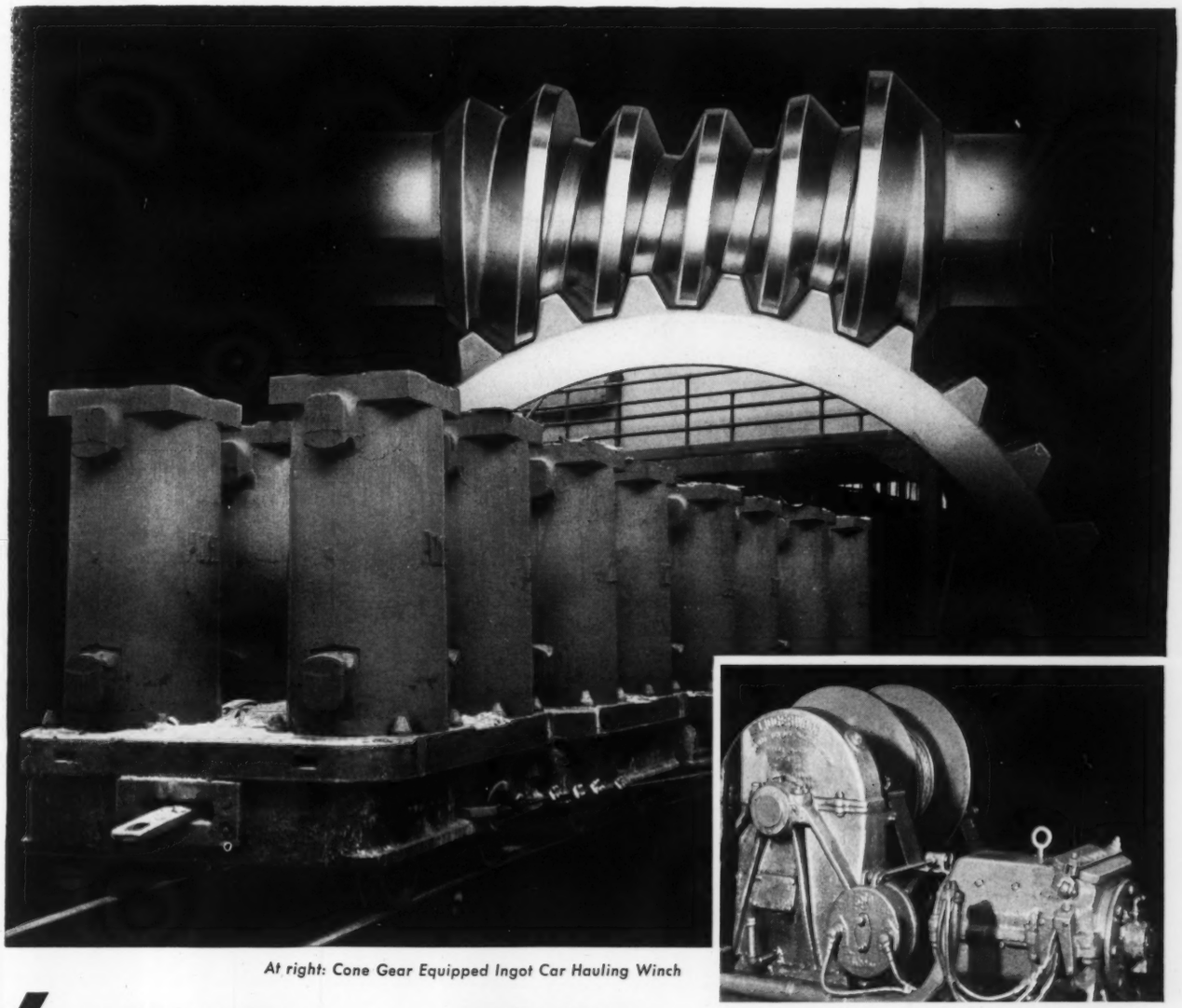


Fig. 3—*Mercury switch in gage controls machine. Section A-A shows operating diaphragms*

forced into the tube and makes contact with one or both of the adjusted terminals, thereby closing the circuits for the desired electric mechanisms. As the mercury falls the circuits are opened at the required points.

To compensate for temperature variations, a mercury height line on the head corresponds with the height of mercury in the free chamber. The volume of mercury in each chamber and tube bear the same relation as their respective volumes. Therefore the rise and fall of mercury in each tube will synchronize with temperature variations. A set screw with spring on the central shaft is manually adjustable to compensate for these variations.

Combinations of this device may include many applications in addition to automatic machine control. For example it may be mounted in such a manner that the contact point is normal to a plane surface. Distance between point and surface is adjusted so that when an article of a given size is placed between them the mercury in the tube makes contact with the lower of the two terminals and a lamp of a given color lights. If an article is so large that increased pressure on the diaphragm causes the mercury to make contact with the upper of the two terminals, a lamp of another color lights to indicate oversize. Likewise articles too small would not cause either lamp to burn.



At right: Cone Gear Equipped Ingot Car Hauling Winch

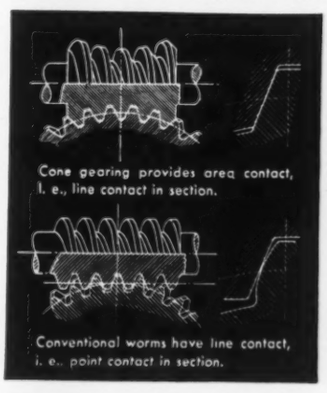
6 YEARS *of* FORD INGOT-HAULING

Early in 1933, Ford Motor Company installed a "temporary" winch in the Rouge Plant Steel Mill to haul strings of up to 15 ingot cars, weighing some 20 tons each, around a sharp bend of track from soaking pits to open hearth.

The standard worm gearing in the winch—15½ inch centers, 46 to one ratio, operating at 900 rpm—wasn't built for that load. Gear life was from one to three weeks.

But in April, 1933, a set of Cone Worm Gears, identical in size, ratio, etc. was installed. Today, the "temporary" winch is still there and the Cone Gears as sound and efficient as ever. The gears have outlived cracked winch housings, worn out thrust bearings, sprung shafts, strains great enough to break a 35 ton cable.

with
One Cone Gear Set


Cone gearing provides area contact, i. e., line contact in section.
Conventional worms have line contact, i. e., point contact in section.

CURRENT CONE OPERATING RANGES
Ratios . . . . . Low, 1 to 6; High, 150 to 1
Speed . . Low, 1/15 rpm.; High, 30,000rpm.
Sizes (C. D.) Low, 5/8 in.; High, 27½in.

The answer is "Cone" worm gearing's AREA CONTACT—extending the entire depth and substantial portion of the width of each worm and wheel tooth in engagement—and with more teeth in engagement. That the Cone gears at Ford are quieter today than they were six years ago is due to the fact that Cone worms *and* wheels (because of their method of generation) tend to re-generate the original form in service.

And the contact surfaces ride on a film of oil—automatically maintained by the pumping action of the entering worm teeth.

A note on your letterhead will bring you Bulletin No. CW-3 describing design, manufacture and typical applications of Cone Worm Gearing.

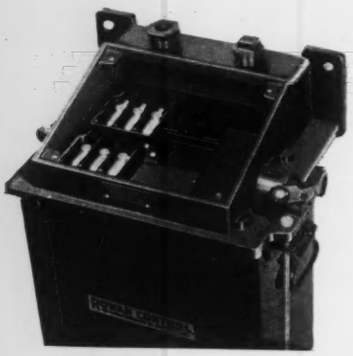
CONE WORM GEAR DIVISION **MICHIGAN TOOL COMPANY**
7171 E. McNICHOLS ROAD, DETROIT

New Materials and Parts

(For Engineering Department Equipment see Page 80)

Safety Featured in Motor Starter

THE type 780-KBF combination across-the-line alternating current motor starter, completely oil-immersed, announced by The Rowan Controller Co., 2313 Homewood avenue, Baltimore, incorporates certain advances in oil-immersed equipment. Necessity of special preparation of lead wires to make them impervious to oil has been eliminated by a sealed wiring chamber which prevents any oil or oil vapor from coming in contact with wires. The safety jack is a feature assuring a maximum of safety to the maintenance men. When this jack in the separate wiring chamber is removed the entire starter is dead. Pushbutton operated, the starter has quick-acting heavy duty magnetic contactors with renewable contacts.



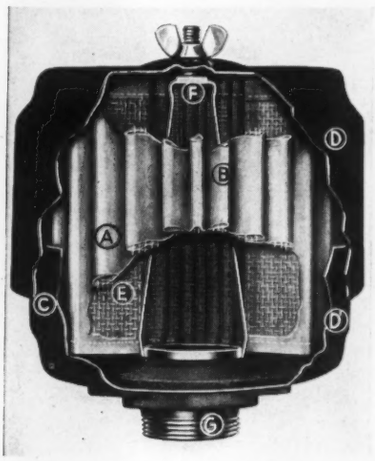
Sealed wiring chamber in motor starter eliminates necessity of specially prepared lead wires to resist oil

Handwheel Selects Variable Speeds

A SINGLE handwheel conveniently located on the side of the Flexoid speed control developed by Smith Power Transmission Co., 410 Lakeside avenue, Cleveland, selects desired speed, in ratios of 1:1, 2:1, 2½:1, and 3:1. The transmission consists of a semisteel housing containing gear trains actuated by a cam through the handwheel. Input drive from the motor employs either V-belts, chain or gears, or it can be direct-connected. Even greater flexibility is available when a Hi-Lo pulley is installed on the input shaft, providing the operator with a greater range in the variable speed. Gears are mounted on hardened and ground splined shafts. Alloy steel input and output shafts extend through the housing of the unit, with ball bearings at the supporting points.

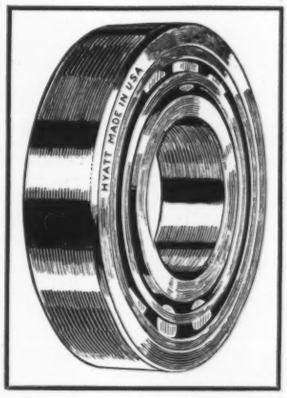
Dry Type Air Filter Announced

EMBODYING the well-known Protectomotor principles, a newly designed dry type air filter, model E, has been announced by Staynew Filter Corp., Rochester, N. Y., for small internal combustion engines, compressors, pumps and all "air-breathing" machines. As shown in the illustration the filter is protected against all weather conditions by the heavily enameled steel housing opening at the bottom. Radial fin construction is indicated by *A*, providing large filtering area in small space. The dry Feltex filtering medium is indicated by *B*. At *C* is shown the intake, approximately double the outlet area, keeping friction and turbulence of the entering air at a minimum. Weatherproof housing is at *D*. The heavy wire mesh backing of the filter insert at *E* and the yoke *F* add to the rigid vibration-resistant qualities of this filter. The yoke and the bolt supporting the upper shell are both spot welded. A threaded flange *G* is provided by means of which the entire unit may be easily removed or installed. Both upright and hanging models are available in capacities ranging from three cubic feet per minute to 225 cubic feet per minute.



Upright and hanging models of dry type air filters for small internal combustion engines are available

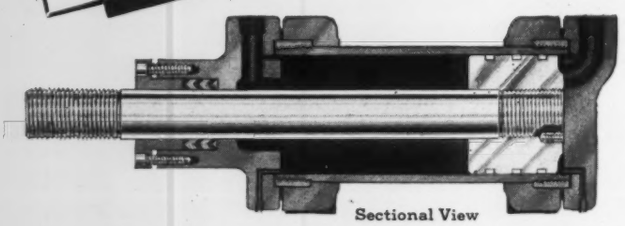
"JITTERBUGS" ARE OUT WHEN HYATTS ARE IN!



To the "swing" of industry, jitterbugs are out when Hyatts are in. Once in, Hyatts hit an even tempo throughout their long lives . . . and never speak above a whisper. Theirs is the song of production, the sweet music of profits. Theirs is a rhythm no machinery builder or user can resist. Our application engineering services are yours to command. Hyatt Bearings Division, General Motors Sales Corporation, Harrison, N. J., Chicago, Pittsburgh, Detroit and San Francisco.

HYATT *Roller Bearings*

SIMPLER hydraulic cylinder design means high efficiency power



Sectional View

The advantages of hydraulic power are made more practical with the new patented construction of Hannifin high pressure hydraulic cylinders. Stronger, simpler construction and easier application makes these cylinders ideally adapted to many uses. High efficiency hydraulic power is assured, with extra ruggedness to withstand severe service.

Check these features: *No tie rods.* End caps removable without collapse of other parts. *Universal caps.* Positioned independently with inlet port at top, bottom, or either side. Caps may be moved without disturbing mounting. *Air vent plugs.* Each cap has air vents on three sides. *Leakproof.* Special mirror finish honing produces a cylinder bore that is straight, round, perfectly smooth, concentric with the end caps. Perfect piston seal and minimum friction loss.

Many types and sizes. Available in six standard mountings, with small diameter piston rod, 2 to 1 differential piston rod, or double end piston rod, in all sizes, for working pressures up to 1000 and 1500 lbs. sq. in. Furnished with or without cushion. Other types built to order, any size, for any pressure.

New Bulletin 35-MD gives complete descriptions.

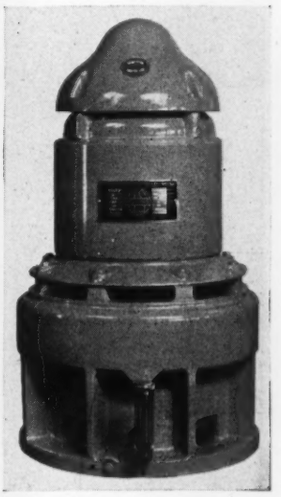
HANNIFIN MANUFACTURING COMPANY
621-631 South Kolmar Avenue, Chicago, Illinois
Engineers • Designers • Manufacturers
Pneumatic and Hydraulic Production Tool Equipment

HANNIFIN
HYDRAULIC CYLINDERS

and in a wide selection of standard pipe sizes.

Motor Incorporates Geared Oil Pump

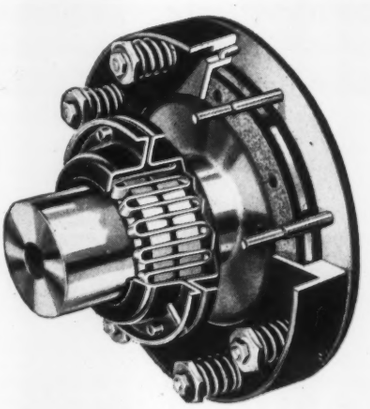
ESPECIALLY designed to meet conditions peculiar to vertical operation, a new Syncrogear motor incorporating a small geared oil pump which forces an ample oil supply to bearings, gears and pinions has been announced by U. S. Electrical Motors Inc., Los Angeles. The unit is shown with a flange base.



A small geared oil pump forcing an ample oil supply to bearings and gears has been incorporated in Syncrogear motor

Coupling Gives High Load Protection

THE controlled torque Steelflex coupling offered by the Falk Corp., Milwaukee, is said to afford protection against peak loads which might range anywhere from 500 to 1000 per cent of the normal torques and snap off shafts, damage housings, etc. In addition, it is claimed this coupling also performs the usual duties of a resilient coupling, such as damping out shocks, reducing vibration, allowing parallel and angular shaft misalignment.

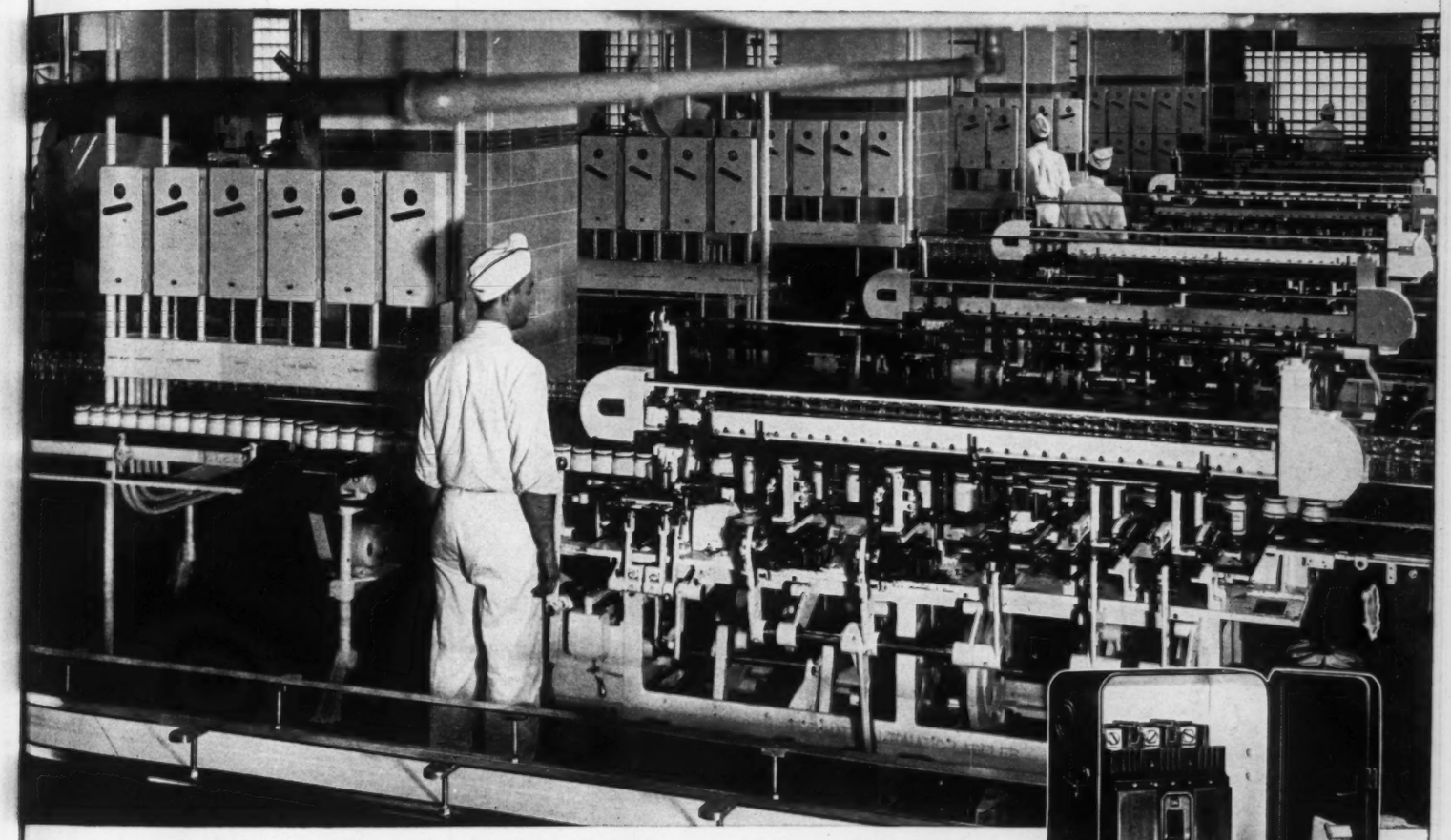


Protection against peak loads ranging from 500 to 1000 per cent of normal torques is provided by coupling

Needle Bearing Capacity Increased

A NEW design of full type needle roller bearing known as the "Solidend" Multirol has been announced by McGill Mfg. Co., Valparaiso, Ind., giving

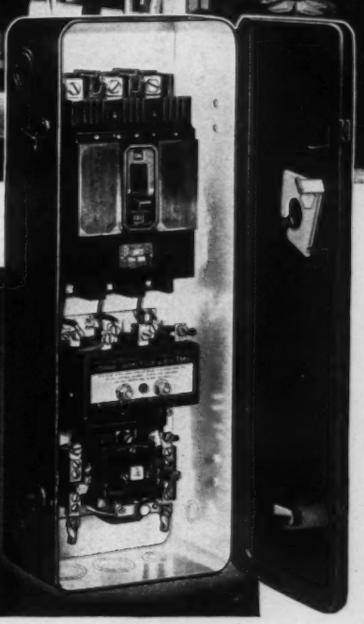
HERE IS THE WAY TO PROTECT YOUR PRODUCTION LINES against needless shutdowns



Thirty-seven A-B starters can be seen in this photo of the Miracle Whip production lines in the new Kraft plant in Chicago.

Burned contacts . . . sticky bearings . . . broken jumpers . . . heat-weakened contact springs . . . these are the usual causes of starter failures. Any of these troubles may stall your production lines—without warning!

Why not insure against manufacturing interruptions by equipping your machines with Allen-Bradley solenoid starters? They are amazingly simple. There are no bearings to stick . . . no jumpers to break . . . no springs to weaken. Overload relays safeguard your motors from dangerous overloads. And the patented silver alloy contacts never need any maintenance. Specify Allen-Bradley solenoid starters . . . and play safe!



Bulletin 713 Combination Starter—an automatic solenoid starter and a hand-reset circuit breaker combined in one cabinet. Large industrial plants are standardizing on these new Allen-Bradley combination starters.

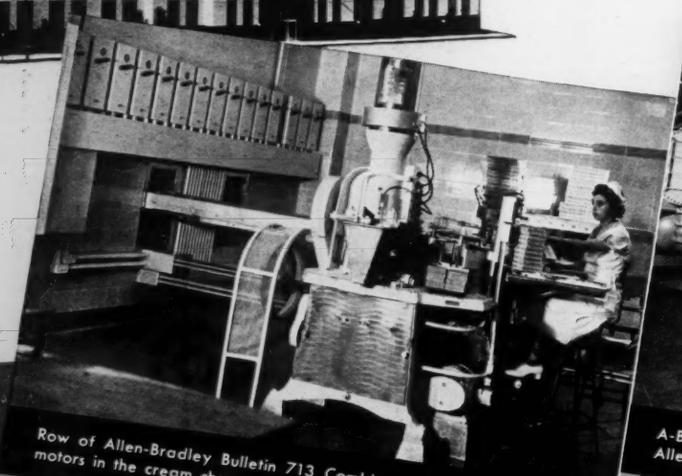
A-B

ALLEN-BRADLEY

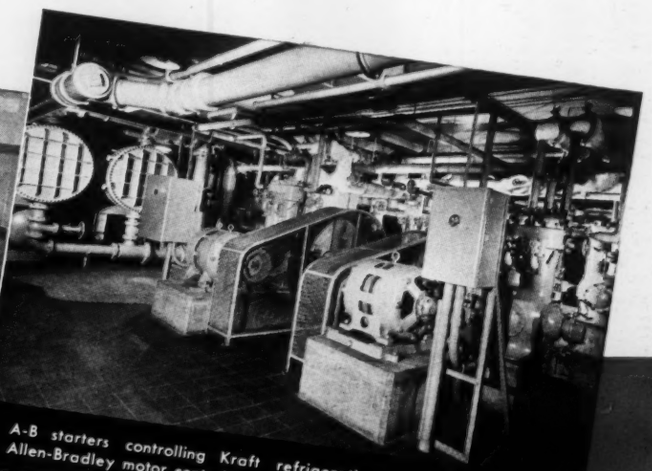
SOLENOID MOTOR CONTROL

HOW KRAFT
automatically controls the motors in their new Chicago plant

You will find Allen-Bradley solenoid starters and push button control stations on all of the important production lines in the new international headquarters building of the Kraft-Phenix Cheese Corporation, in Chicago. These Allen-Bradley starters are as modern and efficient as every other part of this fine new plant. They were selected on their record of performance in other Kraft plants. Specify Allen-Bradley control for *your* motors.

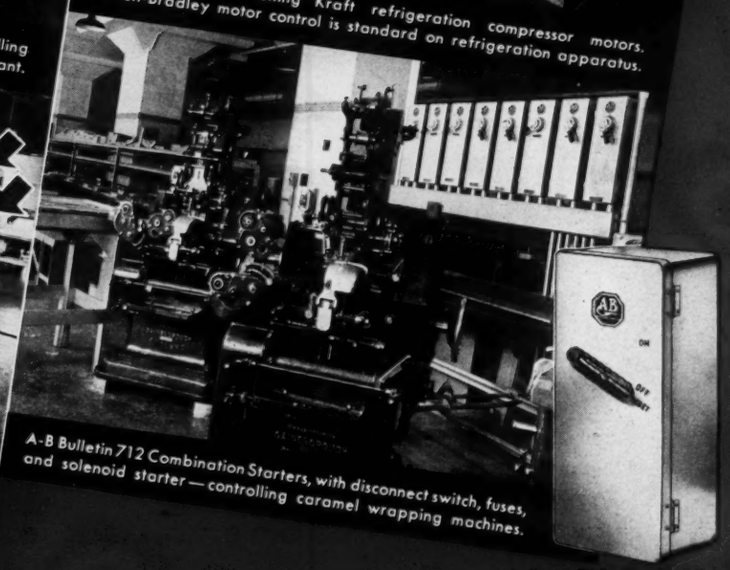


Row of Allen-Bradley Bulletin 713 Combination Starters controlling motors in the cream cheese packaging lines of the new Kraft plant.



A-B starters controlling Kraft refrigeration compressor motors. Allen-Bradley motor control is standard on refrigeration apparatus.

View of the plant scale laboratory where processes are tested with miniature equipment. Note the many Allen-Bradley starters.



A-B Bulletin 712 Combination Starters, with disconnect switch, fuses, and solenoid starter — controlling caramel wrapping machines.

Bulletin 713 Combination Starter with special white enameled enclosure.

SEND FOR "THE STORY OF THE SOLENOID STARTER"

ALLEN-BRADLEY

Allen-Bradley Company
1333 S. First Street
Milwaukee, Wisconsin

Please send me "The Story of the Solenoid Starter.

Name.....

Company.....

Address.....

City.....State.....

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL

What Design Engineers are doing with Silverlink Roller Chain!

DRIVE COSTS SLASHED

Empire Sheet & Tin Plate Co. in the modernization of their Mansfield, Ohio plant used Silverlink roller chain drives to improve their cold-rolling mill operation. As compared to gear drives, their smoother operation resulted in a better finish of steel plates; maintenance expense was greatly reduced and the initial cost was only one-ninth as much as gears.

Ice Cubes from block ice . . . Safer and Faster!

An ice cubing machine that automatically cuts a 325-lb. block of ice into cubes in six or seven minutes was developed by the M. J. Uline Co. In this machine, Silverlink roller chain is used to lift the ice to the saws and for moving the saw carriages back and forth across the ice. This ingenious machine saves fingers and prevents injured hands besides speeding up ice cube production.

L-B takes its own medicine!

In designing its new two-roll spring relief coal crusher, Link-Belt has used a Silverlink roller chain drive. This type of drive provides such advantages as easier and greater size adjustability and a more uniform product due to smoother operation and absence of backlash.

● Put Silverlink roller chain on your "Sales Staff" by incorporating it, in the design of motive equipment which you develop — either as a driving or conveying element.

With its silver-colored side bars and black curled rollers, Silverlink has "eye appeal" which enhances the appearance of any machine on which it is used.

And — what is more important — it has features, such as the Link-Belt shock-absorbing curled roller, which give added service values.

Silverlink's superior performance will sustain the fullest economic values of *your* machines. Send for Engineering Data Book No. 1757. It is a handbook of roller chain practice and design.

Link-Belt Company, Indianapolis, Chicago, Philadelphia, Atlanta, San Francisco, Toronto. Offices and distributors in principal cities.

7771-A

LINK-BELT *Silverlink* ROLLER CHAIN

Tagged

FOR GREATER CUSTOMER ACCEPTANCE

THIS APPARATUS
IS WIRED WITH
GENERAL ELECTRIC
FLAMENOL
REG. U. S. PAT. OFF.
THE NEW FLAMEPROOF OIL- AND MOISTURE-RESISTING WIRE THAT IS STRONG MECHANICALLY AND ELECTRICALLY
MADE IN U. S. A.
N.P.71428

FLAMENOL

REG. U. S. PAT. OFF.

NOW 12 COLORS

Black, white, yellow, red, brown, light blue, green, purple, orange, navy blue, gray, and pink

Easy to Trace Circuits

YOUR customers will take it for granted that your product is just a little bit better if it is wired with G-E Flamenol. They are becoming more aware of the fine record of the 5,000,000 feet now in service.

This is especially true if the wiring is exposed to oil Better than any other compound that we know of, Flamenol resists mild acids and oils.

But it has other advantages for the wiring of high-grade equipment—flame resistance, 12 colors, small diameter, and long life. Flamenol may thus be the answer to many a wiring problem that has long been troublesome, and our engineers will be glad to work with a manufacturer to determine whether it is the answer. Address the nearest G-E sales office, or General Electric, Dept. 6 -201, Schenectady, N. Y.

APPROVED

Flamenol oil-resisting wire is recommended and approved by the Underwriters' Laboratories, Inc., as Type FL, for use within appliances (machines) where exposed to air and to temperature not exceeding 170 F (80 C). It is also approved for other uses, see Bulletin GEA-2733C.

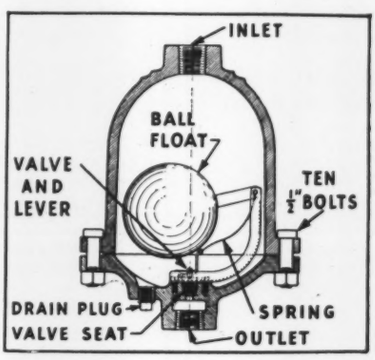
GENERAL ELECTRIC

520-167

an increase in load-carrying capacity of as much as 12 per cent over previous designs. The new outer race construction holds roller integral without use of end washers and retaining end rings. Roller retaining shoulders are built integral with the outer race so that the possibility of accidentally bending or breaking endwashers is eliminated. Extra load-carrying capacity is attained by using full length rounded end rollers instead of the usual trunnion or conical ends, increasing effective race and roller contact. A variety of size combinations that can be used with or without the separable inner races in shaft sizes up to five inches is available.

Mechanical Trap Drains Water

AN AUTOMATIC snap-action mechanical trap for draining water from compressed air lines, tanks, separators and aftercoolers has been introduced by the Armstrong Machine Works, 843 Maple street, Three Rivers, Mich. As the diagram shows, the trap has a ball float connected to the short valve lever through a flat strip of stainless spring steel. In the closed position this spring is bowed downward. As water enters the body of the trap the ball float rises, bending and storing up energy in the spring. Just before the ball float reaches the trap top the spring bends past dead-center and the stored-up energy snaps the valve wide open, bowing the spring upward. As the water level drops in the trap body, the cycle is reversed and the valve snaps shut. Capacity claimed is 1400 pounds of water per hour at 125 pounds pressure and 1000 pounds per hour at 250 pounds pressure.



For draining water from compressed air lines, tanks or separators an automatic snap-action mechanical trap has been introduced

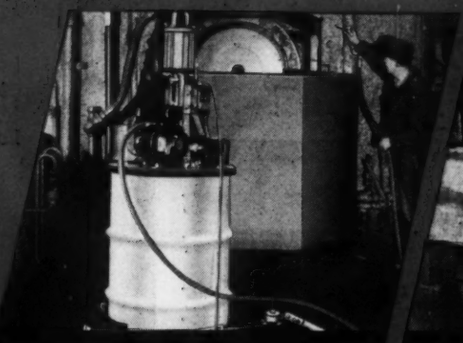
Pillow Block Made in One Piece

SEVERAL parts have been eliminated in the new one-piece steel housing pillow block announced by Randall Graphite Products Corp., 609 West Lake street, Chicago. A saving of one-third in weight has been attained. To cover a range of installation requirements this pillow block can be mounted in any position by turning the ball on its horizontal axis to a position allowing the oil cup to be mounted upright. Oil capacity has been increased by a new precision-

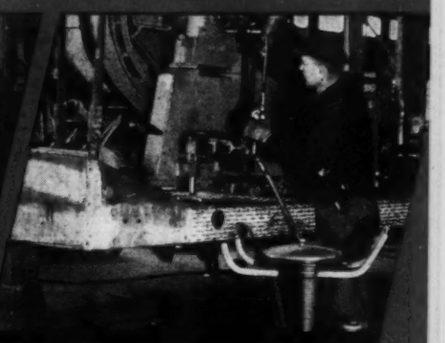
SPEED, CLEANLINESS, SAFETY, ECONOMY THESE ARE *Reasons Why-*

SO MANY INDUSTRIES DEPEND ON ALEMITE!

REG. U. S. PAT. OFF.



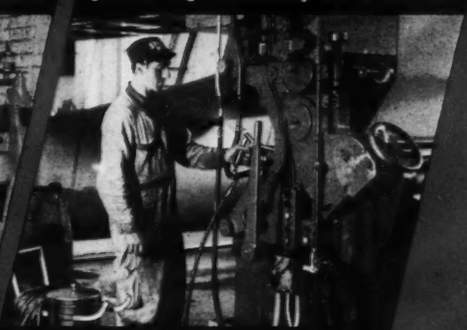
IN STEEL MILLS this Alemite Electric Gun makes history, providing volume delivery at high pressure.



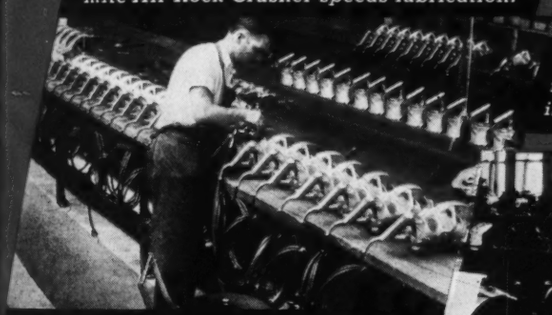
FOR HEAVY MACHINERY Alemite high pressure lubrication safeguards big machinery investments.

IN FOUNDRIES speed is all-important. Molten metal doesn't wait. Here the Alemite Air Rock Crusher speeds lubrication.

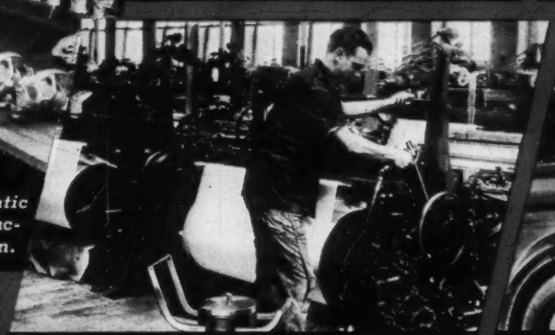
IN CANNERIES cleanliness must rule! Alemite Equipment puts grease into bearings, keeps it from food.



IN PAPER MILLS one bearing failure may tie up a block-long machine. Most mills use Alemite.



ON ASSEMBLY LINES rapid automatic dispensing of lubricant accelerates production. It's easy with an Alemite Power Gun.

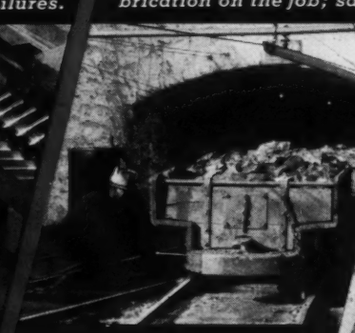


IN TEXTILE MILLS Alemite lubrication avoids contamination of products, saves time, reduces bearing failures.

ON CONSTRUCTION JOBS the Alemite Portable Service Station provides power lubrication on the job; saves important time.

ON STAMPING PRESSES, bearings carry terrific loads. Alemite Power Guns do a thorough job.

ON CONVEYORS of all kinds, dependable Alemite lubrication helps prevent breakdowns, production delays.



IN MINES the Alemite Volume Gun can easily service several outlets at once.

IN PACKING PLANTS the cleanliness of Alemite lubrication prevents contamination, avoids waste.

ALEMITE
REG. U. S. PAT. OFF.

A Division of Stewart-Warner Corporation, 1804 Diversey Parkway, Chicago, Ill.
Stewart-Warner-Alemite Corporation of Canada, Ltd., Belleville, Ontario

WORLD'S LARGEST MANUFACTURER OF LUBRICATION PRODUCTS

HOW FARVAL EARNS FOR YOUR CUSTOMERS:

Reduces power consumption. Eliminates labor of oiling. Saves lubricant. Reduces repair bills. Prevents shut-downs for bearing repair or replacement. Prolongs machine life.

Correct lubrication of all bearings by a Farval Centralized System provides not merely one, but *many* ways by which your customers may realize greater output and larger profits from the production machines you build.

"Reduces power consumption" is one of several advantages listed above. On one large Farval installation, power savings alone amounted to *$19,000.00 in a single year.*

FARVAL INSURES

The Farval Centralized System insures immediate and positive delivery to every bearing in less than one minute from one safe, conveniently-located central pumping unit. Every bearing receives exactly the amount of lubricant it requires, regardless of the number of bearings or where located.

The years of experience gained by Farval in the design and application of lubricating systems to all types of equipment are available to you through our staff of trained Lubricating Engineers.

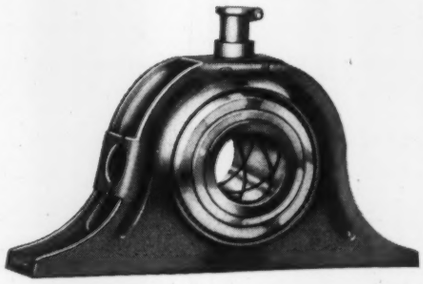
There is one in your locality and he will be glad to call. The Farval Corporation, 3265 East 80th Street, Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Manufacturers of Automotive and Industrial Worm Gearing

FARVAL

CENTRALIZED SYSTEMS OF LUBRICATION

machined cast iron ball. The entire assembly, consisting of only three parts, is cadmium plated to resist corrosion and is available in shaft sizes from ½-inch to 1 inch.



Saving of one-third in weight has been attained in new one-piece steel housing pillow block

Duplex Welding Hose Developed

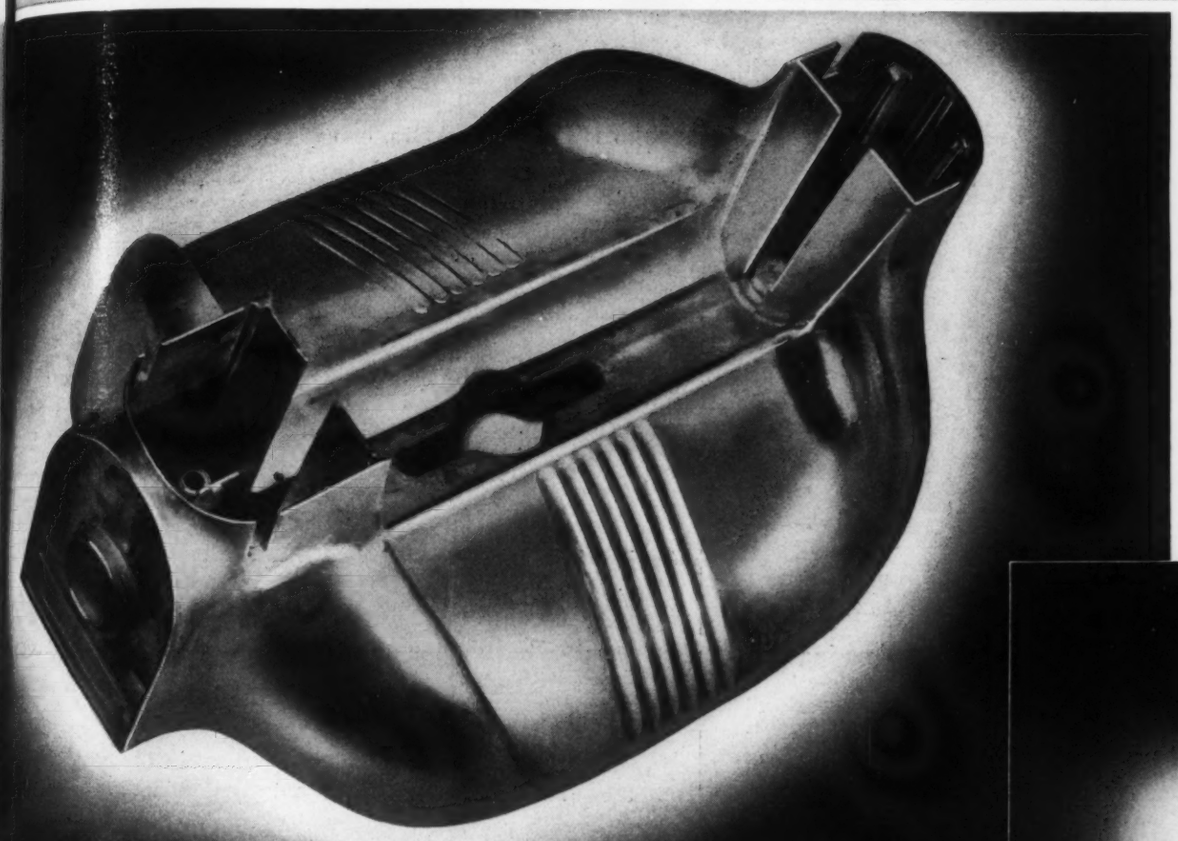
IN THE construction of Condor duplex welding hose, a new development of The Manhattan Rubber Mfg. division, Passaic, N. J., two hose lines are held together by a permanent web joint, integrally molded, with great strength and flexibility. The joint prevents tangling, kinking and snagging. Ends are separated 18 inches for the torch end and 24 inches for the tank end for ease in making connections and in handling. Condor duplex hose may be obtained in either one or two braid, or in heavy duty braid and spiral cord construction, depending upon the working pressures used. Other features are strong inner tubes that are smooth and nonporous, and tough, flexible covers with a maximum resistance to abrasion and aging.

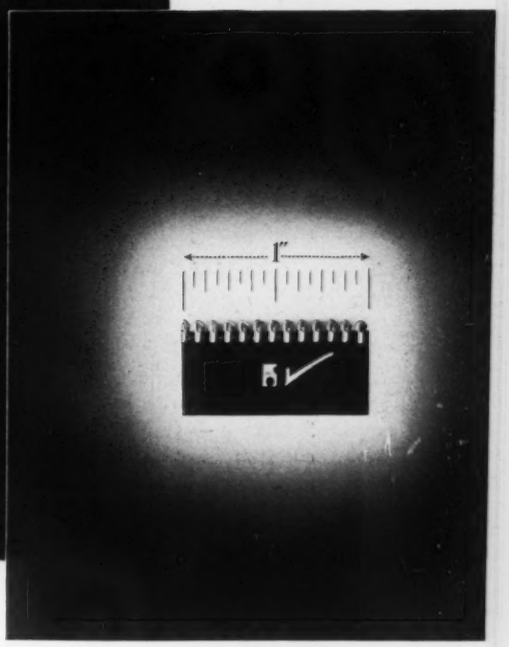
Timer Indicates Machine Operation

NATIONAL INSTRUMENT CO., 44 School street, Boston, has announced model 161-L Timeter with indicating lamp, for keeping an accurate record of production hours and showing operation of a machine at a glance. Electrically operated, the timeter is a counter with a small slow-speed synchronous motor driving a set of numbered wheels through a gear train. Avail-

An accurate record of production hours is kept by timeter and operation of machine is shown at a glance

ZINC ALLOY DIE CASTINGS





11½ POUNDS

—or .022 gram

ZINC Alloy Die Castings are not restricted by size (within reason, of course). If a maximum or minimum were set it would probably be exceeded tomorrow.

1. SIZE—The large casting is a washing machine wringer frame—the small one (indicated with a check) is a slide fastener element. One weighs 11½ pounds and measures 18½″ x 13″ x 6⅝″. The other weighs .022 gram and measures 7/64″ x 1/16″ x 1/4″. Both are pressure die cast of ZINC Alloy.

2. INTRICACY—Whether a part be large or small, intricacy may be an important requirement. Note the *completeness* of the wringer frame casting—all of the necessary elements are embodied *in one part*. For example, provisions have been made in the end sections for fastening the wringer gearing. This means machining and assembling economies. A magnifying glass reveals the comparative intricacy of the slide fastener element, too.

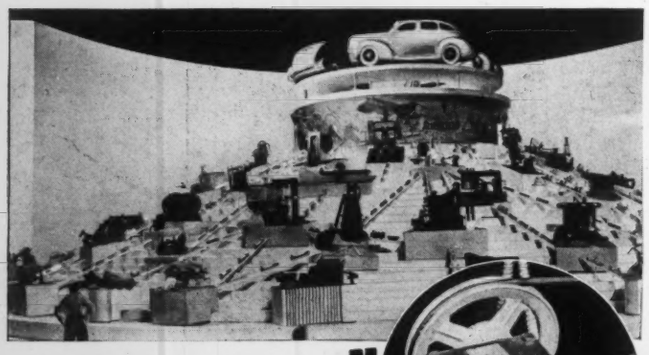
3. ACCURACY—The die casting process makes it possible to secure extreme accuracy of shape and dimensions—of prime importance in the performance of the parts shown here. The ZINC Die Casting Alloys not only insure the retention of these dimensions, but they are responsible for the many other excellent physical characteristics as well.

If you would like to have more information on die castings we suggest that you consult a commercial die caster. We will be glad to answer your questions on the ZINC Die Casting Alloys.

THE NEW JERSEY ZINC COMPANY
160 Front Street New York

The Research was done, the Alloys were developed, and most Die Castings are specified with

HORSE HEAD SPECIAL (99.99+% UNIFORM QUALITY) ZINC



"Action"

© N.Y.W.F.

AT THE FORD EXHIBIT

Action — that's the attention-getting formula for Fair exhibits. And the huge Ford display, "The Ford Cycle of Production" makes dramatic use of action in presenting the impressive parade of materials that go into the making of the Ford car of today.

Andrews and Perillo, Inc. of Long Island City, N. Y., who built the animating machinery used 70 Ohio Gear Reducers to translate the power of electric motors into the arresting, life-like action that tells the story as the giant turntable revolves.

They tested many reducers on these points: Case Strength — Oil Seals — Torque Efficiency — Type of Bearings — Sturdy Construction — Variety of Sizes and Ratios — Cost. *Then they chose Ohio Gear Reducers.*

You, too, will find the high efficiency, satisfying performance and moderate cost of Ohio Gear Reducers well suited to your needs. Get all the facts, write, on your letterhead, for your new 1939 Catalog.

THE OHIO GEAR CO.

1338 E. 179th Street • Cleveland, Ohio

Representatives

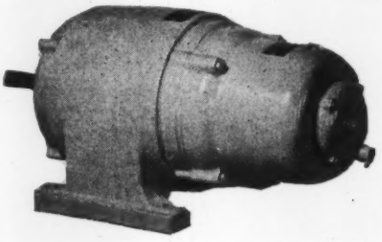
*Los Angeles, Calif. J. W. Minder Chain & Gear Co., 927 Santa Fe Avenue.
*San Francisco, Calif. Adam-Hill Co., 244-246 Ninth St.
Indianapolis, Ind. A. R. Young, 518 North Delaware Street.
Pittsburgh, Pa. Industrial Sales & Engineering Co., Box 8606, Wilkinsburg, Pa.
Detroit, Mich. George P. Coulter, 322 Curtiss Building
Buffalo, N. Y. F. E. Allen, Inc., 2665 Main Street.
*New York City, N. Y. Patron Transmission Co., 154-156 Grand Street.
New York City, N. Y. E. G. Long Co., 50 Church Street.
Grand Rapids, Mich. W. H. Slaughter, 419 Oakdale St., S. E.
New England, George G. Pragst, 260 Esten Ave., Pawtucket, R. I.
Louisville, Ky. Alfred Halliday, 330 Starks Building.
Salt Lake City, Utah. A. O. Gates, 619-629 South Fifth West Street.
*Stocks carried.

OHIO GEARS

able with a relay, this timeter is connected directly across the terminals of any alternating current device of the same voltage and frequency rating. Rating is 100 to 125 volts, 60 cycles, two watts.

Motors Reverse Rapidly

A NEW line of squirrel cage motors put on the market by Sterling Electric Motors Inc., Los Angeles, has been developed to simplify certain designs requiring frequent reversals in direction of rotation. This motor with control is said to stand up under continual and frequent reversals as high as one per second at full voltage without undue



Squirrel cage motors are available in sizes and speeds up to ten horsepower

heating or deterioration. Frame, shaft and bearings of the unit are sturdy, with micabestos-insulated stator windings. Stator and rotor windings are efficiently cooled with continuous forced ventilation through the use of a small, auxiliary motor and squirrel cage fan at one end of the motor. These motors are available in a number of sizes and speeds up to 10 horsepower.

Two Motorpumps Added to Line

TWO new centrifugal motorpumps have been added to the line made by Brown & Sharpe Mfg. Co., Providence, R. I. Known as the Nos. 220 and 240, these pumps are suitable for supplying coolant for machine tools and light machinery where dirt or abrasives may be present in the liquid. (See *M.D.* March, p. 70, and January, p. 62, for descriptions of similar motorpumps.) No. 220, illustrated, is designed for operation with the impeller below liquid level. It can be mounted in practically any position,

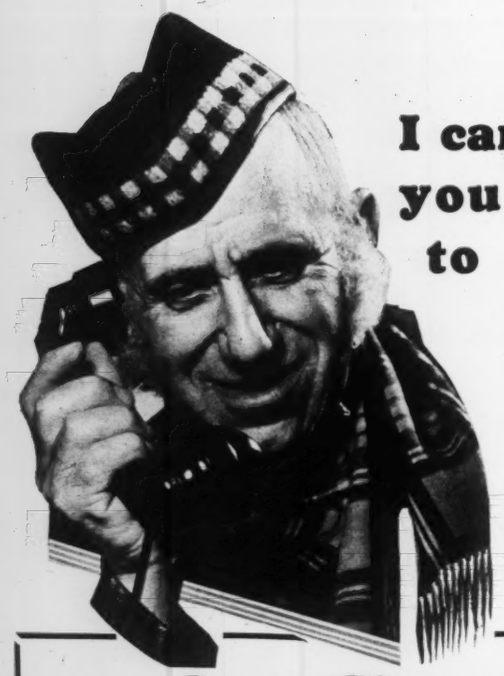
Centrifugal motorpumps have been added to line for supplying coolant for machine tools and light machinery

either horizontally or vertically, but the motor preferably should be above the pump. A mechanical seal which does not require adjustment and which protects the shaft from wear prevents leakage of liquid. No. 240 is similar but has flange mounting integral

LONG RANGE LIVE ACTION—an *exclusive* advantage in Helical Spring Washers—brings to *your* products greater safety, longer service, better customer satisfaction. It costs you nothing extra and is exclusive in Helical Spring Washers. • *Initial* looseness in bolted structures is caused by wear of contacting surfaces and bolt stretch. *Long range Live Action* compensates for initial looseness by exerting powerful, *maintained* pressures on thread surfaces. Guarded by Helical Spring Washers, *bolted parts remain tight!* • Be safe! Specify only Helical Spring Washers in *your* products.

SPRING WASHER INDUSTRY • 616 Wrigley Building • Chicago, Illinois

ONLY A HELICAL SPRING WASHER HAS LIVE ACTION



I can tell you how to . . .

. . . Save Clearance, Material, Weight, Cost

Many designers are now adopting smaller, lighter flanges, with resultant savings and with no sacrifice of strength. This is simply accomplished by discarding ordinary hex head bolts and using

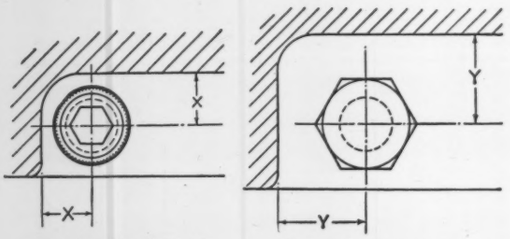
KNURLED

UNBRAKO

SOCKET HEAD CAP SCREWS

Fig. 1434 Pats. Pend.

instead. The plan views below clearly show how the Knurled "Unbrako" makes this saving possible. Remember also, by bringing the screw head closer to the joint, holding-power increases.



See how the Knurled "Unbrako" snuggles right into the corner.

Notice the great open spaces necessary for the hex head and wrench.

Knurled heads of "Unbrako" dress up the finished product, many users say.

Let us tell you about other advantages. Write today for catalog.

STANDARD PRESSED STEEL CO.

BRANCHES BOSTON DETROIT INDIANAPOLIS

JENKINTOWN, PENNA.

BOX 102

BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

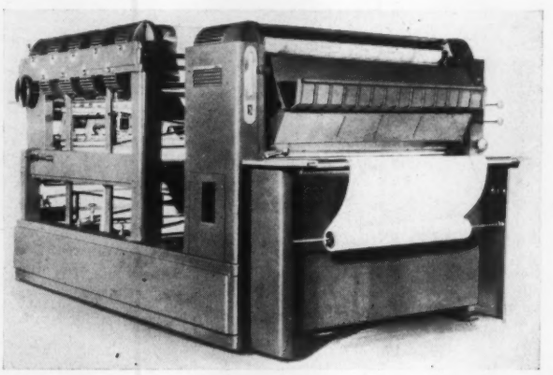
with the pump and does not require inlet piping. It is intended to be mounted in a vertical position but can be used in a horizontal position if desired.

Synthetic Enamels Bake Quickly

A NEW line of synthetic enamels, with very short baking schedules, has just been placed on the market by Maas & Waldstein Co., Newark, N. J. These new finishes, known as "Polydur" enamels, were developed to enable manufacturers speed up production by reducing the time needed for finishing. Polydur enamels set out of dust in a few minutes. Their baking schedules depend upon the temperature employed.

Continuous Blueprinter Introduced

UTILIZING actinic arc lamps controlled through a new switch arrangement permitting the lamps to operate at any one of three speeds, the C. F. Pease Co., Chicago, has introduced a continuous blueprinting, washing and drying machine. Streamlined, the machine is designed to give the operator maximum operating facility. Production rate for large tracings is 24 linear feet per minute on direct current or 18



Maximum operating facility has been attained in new continuous blueprint machine, using arc lamps at three speeds

linear feet per minute on alternating current. On smaller tracings the built-in speed variation permits use of slower speed blueprint paper. The washer comprises three horizontal water tanks upon which the paper floats as it is washed, eliminating tension wrinkles and distortion. Nine aluminum drums dry the paper evenly and flatly at low gas or electricity consumption.

Stroboscopes Study Speed, Motion

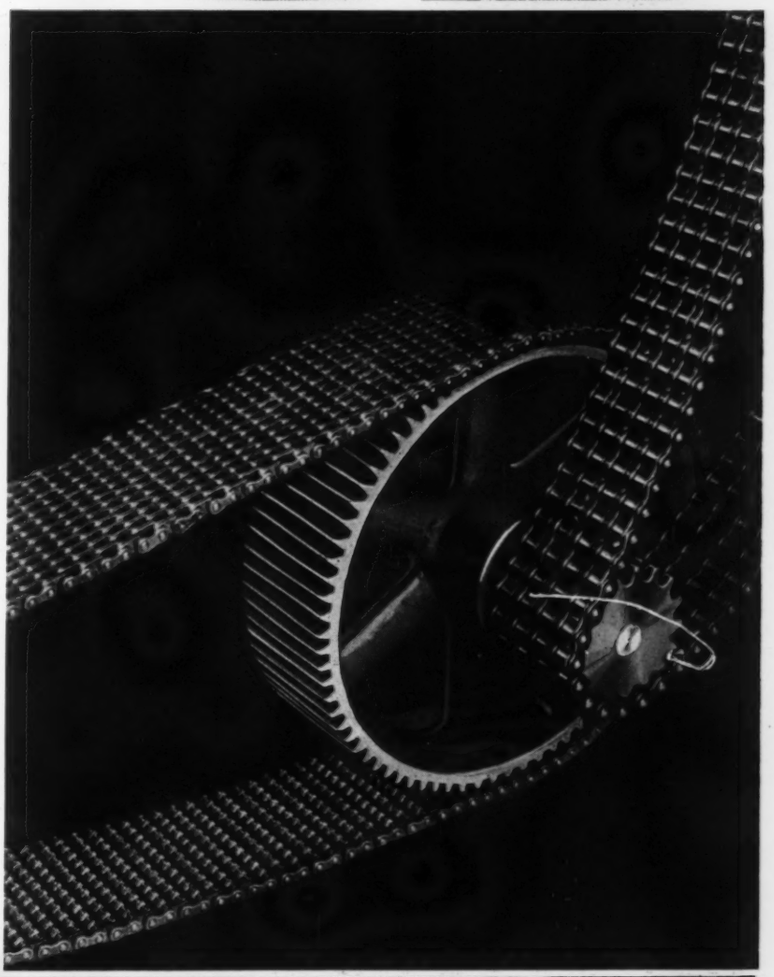
TWO stroboscopes announced by General Radio Co., 30 State street, Cambridge, Mass., are portable units suitable for both speed measurement and slow motion studies of rotating and reciprocating mechanism such as motors, gears, shafts, fans, pumps, cams, etc. Speed measurements with an accuracy of plus or minus 1 can be made with the type 631-B

WRITE IN Whitney FOR CHAINS

and write up Your Power Efficiency

Convert your power input into the fullest measure of production output. Equip your machines for instant power-responsiveness with Whitney Chains . . . and get the utmost productive capacity. Whitney Chains are built for strength, long life, and overload capacity on high, medium and low-speed drives. Design these proven Whitney features into *your* machines . . . and step up your power efficiency. You are invited to consult Whitney engineers freely on all your chain problems.

Write for Whitney Catalogs on:
Roller Chains . . . Silent Chains
Conveyor Chains . . . Sprockets
Flexible Couplings



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The WHITNEY CHAIN & MANUFACTURING COMPANY, *Hartford, Connecticut*

Multiple Spline is BASIC ENGINEERING DESIGN

TAUGHT AS STANDARD WAY BACK IN SCHOOL DAYS.

IN WIDE USE WHEREVER POWER MUST BE UNFLINCHINGLY TRANSMITTED.

AN old acquaintance from way back in your school days, multiple spline design now serves you on Bristo Socket Screws. Good reason!

Here is power unflinchingly transmitted from the wrench to the screw. No loose, wobbly contact here. No wasted motion. No slipping. Extra strength can be exerted on the turn with no danger of splitting, shearing or rounding the socket. Bristos set tighter, stay tighter. Assemblies take less time. Production costs are cut. Isn't that what *you* want?

Put Bristos on your assembly and prove these advantages for yourself. Send today for sample Bristos and illustrated, informative Bulletin 83-5N. No obligation. The Bristol Company, Mill Supplies Division, Waterbury, Conn.

FEATURES AT A GLANCE!

MULTIPLE SPLINE SOCKET—as positive acting as meshed gears—Won't split, shear, strip, round out, slip or jam—Sets tighter with less effort—No loosening under vibration—Takes wrench without fumbling or skidding.

BRISTO

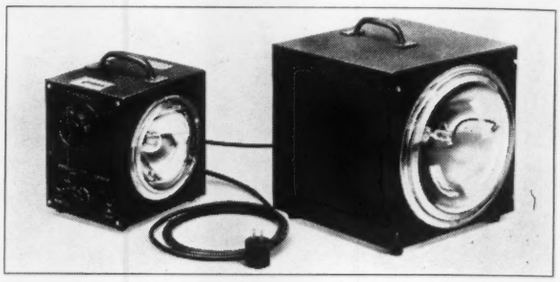
TRADE MARK REG. U.S. PAT. OFF.

Multiple Spline
SET AND CAP SCREWS

Approved by the American Standards Association and the American Society of Tool Engineers

BRISTO MAKES YOUR PRODUCT BETTER

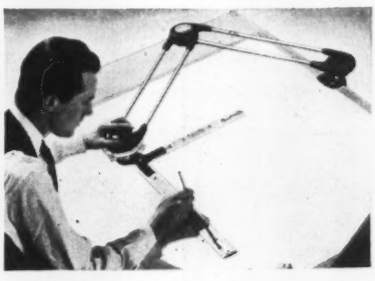
Strobotac, no mechanical or electrical contact with the machine under observation being necessary. The stroboscopic light is directed on the machine and the flashing rate adjusted until the motion appears to be stopped. Speed is then read directly from a scale graduated in revolutions per minute. A larger instrument, the type 648-A Strobolux, furnishes about 100 times as much light as the Strobotac and is used in conjunction with the latter when larger areas are to be illuminated or where background lighting is strong. Both units operate from alternating current, the Strobotac requiring 25 watts, the Strobolux 150.



No contact with the machine under observation is necessary with stroboscopes for measuring speed or studying motion

Drafting Machine Minimizes Fatigue

DESIGNED to minimize drafting fatigue, the new Excello "Free Floating" drafting machine announced by the Eugene Dietzgen Co., 2425 Sheffield avenue, Chicago, is said to permit draftsmen to work for many hours without strain and therefore with greater accuracy. The "free floating" feature which accomplishes this end is obtained through use of new light weight alloys, roller bearings and precision construction, together with an advanced method of gravity control which does not place a drag on the drafting machine's motions. Both friction brakes and overhanging weights are eliminated. Control of angles is directly under the thumb in the protractor head. All moving parts are completely enclosed, eliminating band breakage. Use of noncontinuous bands incorporating a unique automatic tensioning arrangement also precludes breakage by offsetting expansion and contraction which might otherwise take place.



Free floating feature, together with advanced method of gravity control on drafting machine minimizes men's fatigue

SKF BEARING SERVICE COVERS THE WORLD

AMERICAN manufacturers ship SKF-equipped machines to all parts of the world, secure in the knowledge that SKF bearing service is available through SKF factory-owned offices in every civilized part of the world.

SKF has 185 offices in 60 countries—under all flags. Bearing counsel is given in 29 tongues. Bearing problems are solved by a corps of 1500 trained engineers. In addition, there are more than 10,000 authorized distributors. No matter in what part of the world your machine may be, it can always have the right bearing in the right place. SKF Industries, Inc., Front Street & Erie Avenue, Philadelphia, Pa.

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BALL BEARINGS **SKF** ROLLER BEARINGS

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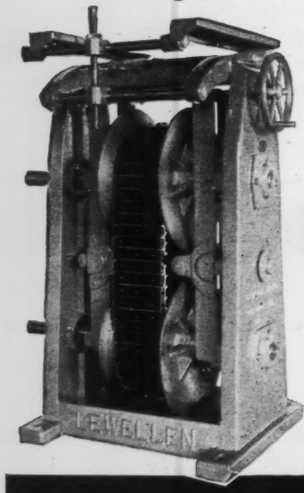
● Efficient, regulated speed control of your production machines is a positive way to lower unit costs—to INCREASE PROFITS.

The application of modern speed control to your production machines may mean the installation of standard Lewellen Transmissions. Or, your problem may be a difficult one, like many that come to Lewellen.

Whether your problem is simple or difficult, your needs small or large, the vast experience acquired by Lewellen Engineers over a period of more than 40 years, is yours for the asking. Call a Lewellen Representative or write us now!



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Lewellen knows speed control

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Variable Speed

TRANSMISSIONS

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MOTOR PULLEYS

Meetings and Expositions

June 5-7—

National Warm Air Heating and Air Conditioning association. Semi-annual meeting to be held in Chicago. Allen W. Williams, 50 West Broad street, Columbus, O., is secretary.

June 5-10—

Edison Electric institute. Semi-annual meeting to be held at Waldorf-Astoria hotel, New York. M. B. Woods, 420 Lexington avenue, New York, is secretary.

June 19-22—

American Electro-Platers' Society. International convention to be held at Asbury Park, N. J. W. J. R. Kennedy, 90 Maynard street, Springfield, Mass., is executive secretary.

June 19-22—

American Society of Agricultural Engineers. Annual meeting to be held at University farm, St. Paul, Minn. Raymond Olney, St. Joseph, Mich., is secretary.

June 26-28—

Marking Device association. Annual meeting to be held at Netherland-Plaza hotel, Cincinnati. W. S. Lord, 431 South Dearborn street, Chicago, is executive vice president.

June 26-30—

American Institute of Electrical Engineers. Summer and Pacific coast convention to be held Fairmont Hotel, San Francisco. H. H. Henline, 33 West Thirty-ninth street, New York, is national secretary.

June 26-30—

American Society for Testing Materials. Annual meeting and exhibit of apparatus and instruments to be held at Chalfonte-Haddon Hall, Atlantic City, N. J. R. E. Hess, 260 South Broad street, Philadelphia, is assistant secretary.

June 24-July 3—

Stevens Engineering Camp. Ninth annual economics conference of engineers to be held at Johnsonburg, N. J. James Creese, Stevens Institute of Technology, Hoboken, N. J., is vice president.

July 4-6—

American Society of Heating and Ventilating Engineers. Great Lakes meeting to be held at Grand Hotel, Mackinac Island, Mich. Additional information may be obtained from the Society headquarters, 51 Madison avenue, New York.

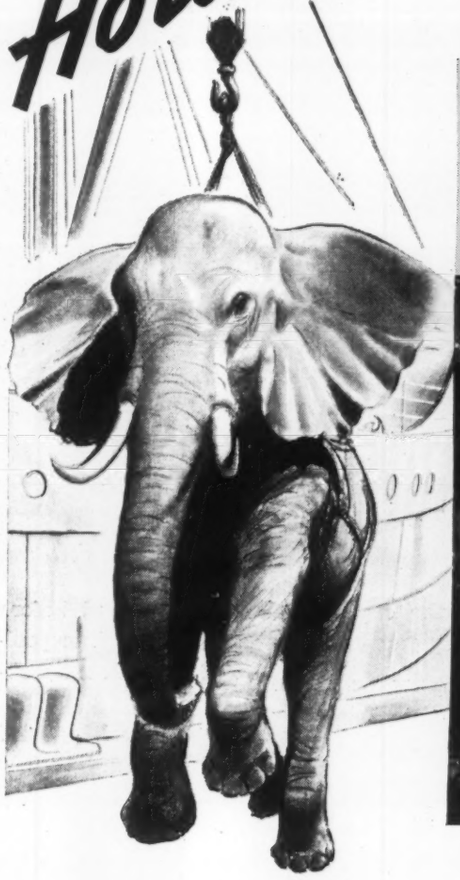
July 10-15—

American Society of Mechanical Engineers. Semi-annual meeting to be held at Palace hotel, San Francisco. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

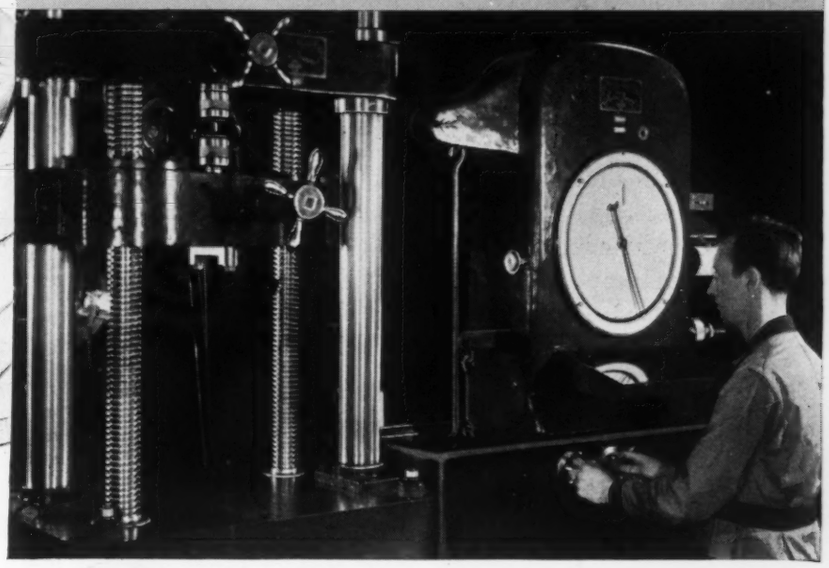
THIS 3/8" CAP SCREW THAT CAN

Hold 5 Tons of Elephant

—BRINGS A RESERVE OF TENSILE STRENGTH TO YOUR SOCKET SCREW FASTENINGS!



TENSILE TESTS, in Parker-Kalon's Laboratory, make certain that Parker-Kalon Cold-forged Socket Screws have high tensile strength *combined with adequate ductility*. For example, a 3/8"—24 (N.F.) Cap Screw must sustain a 13,000 pound minimum static tension load to meet Parker-Kalon's higher standards.



"16 POINT QUALITY-CONTROL" Leads Critical Buyers to Demand PARKER-KALON

This tensile test is only one of 16 check-ups on important characteristics of Parker-Kalon Cold-forged Socket Screws. In a laboratory without counterpart in the industry, quality is guarded by thorough tests and inspections covering:

1—Chemical Analysis. 2—Tensile Strength. 3—Ductility. 4—Torsional Strength. 5—Ability to take Shock Loads under Tension. 6—Resistance to Shock Loads under Shear. 7—Hardness. In addition, there is a rigid inspection of these essentials: 8—Head Diameter. 9—Head Height. 10—Concentricity of Head to Body. 11—Socket Shape. 12—Socket Size. 13—Socket Depth. 14—Centricality of Socket. 15—Class 3 Fit Threads. 16—Clean Starting Threads.

In this way Parker-Kalon maintains a new higher standard of quality in Socket Screws . . . a standard that satisfies critical buyers. Send for free samples . . . see for yourself.

PARKER-KALON CORPORATION, 212 Varick Street, New York

PARKER-KALON Cold-Forged SOCKET SCREWS

. . . CLEVELAND DRIVES MAKE MACHINES PAY BACK FASTER

Because:

NO MAINTENANCE OR REPLACEMENT COST

Blank cards—year after year in the files of companies operating thousands of Cleveland Worm Gear Speed Reducers—give forceful evidence that when properly applied by Design Engineers, Cleveland Drives *do* make machines pay back faster.

1—because they operate dependably throughout the machine lifetime with no replacement and with little or no expense for maintenance.

2—because Cleveland's sound engineering, precision manufacture and correct application safeguard profitable operation and eliminate shutdowns caused by failure of gearing.

The longer you know Clevelands, the greater your confidence in their ability to operate indefinitely for users of your machines. Cleveland Engineers will cooperate in adapting the correct types and sizes to the equipment *you* build.

Have you the Cleveland Worm Gear Book? 150 pages of invaluable data for daily reference and use by the Design Engineer. Your copy will be sent immediately upon request.

The Cleveland Worm & Gear Company, 3275 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication

CLEVELAND WORM GEAR Speed Reducers

In Design—Economize

(*Concluded from Page* 35)

drawing dies which otherwise would be required. Most of the exposed sheet metal parts are chromium plated.

Two rolled moldings of flattened C-shaped section are fitted around the edges of the machine. The moldings are stainless steel provided with flat-head screws slidable longitudinally and projecting inward so that fastening nuts as well as the screws themselves remain hidden. Exposed rods are also of stainless steel chosen because it yields a permanently bright finish without need for plating. A molded plastic slide is fitted to move transversely across the upper part of the working surface. The particular material selected is highly transparent. Printing under it is visible between ruled lines, thereby facilitating proper alignment and location of papers inserted.

The view of the completed machine makes apparent the fact that fine appearance has not been overlooked. This appearance is enhanced by using neat stamped side frame covers and by finishing these, as well as various adjacent parts, in fine grain black crinkled enamel. A pleasing contrast with the satin-finished chrome and stainless steel parts thus is provided.

Selecting Seals, Packings

(*Concluded from Page* 44)

tamped to make certain they are all seated before the pump is operated and the gland pulled into position. Correct utilization of the stuffing box may obviate this trouble.

In the illustration, a counterbore has been die-molded on each side of the rings and an oversized fibrous material has been forced by high pressure to each side. The fibrous material then extends out of the rings so that when the gland compresses all the rings, this dense fibrous outer edge is sufficient to build up a lateral resiliency. This resiliency keeps all rings seated without affecting greatly the metal portion.

In general, one of the greatest mistakes made by designers of equipment requiring packings is to consider the stuffing box indifferently. Efforts are constantly being made to guide designers regarding the cross sections of packings, and in the case of valves in particular, progress has been made. On machinery such as pumping, however, room for improvement exists. Reliable bearings should of course be used, spaced to give sufficient room for adjustments to be made without distorting packings. Glands should be fitted to close tolerances, and in many instances should be of the three-stud type rather than the two.

Thanks are due the following companies for their assistance in the preparation of information and illustrations in this article: Felt Products Mfg. Co. (*Fig.* 7); The Felters Co. Inc.; E. F. Houghton & Co. (*Fig.* 6); Michigan Leather Packing Co. (*Figs.* 3, 4, 5); Western Felt Works (*Figs.* 1 and 2).

20 YEARS AGO, THEY COULDN'T DO IT...

Today.. STEEL CASTINGS MAKE MILE LONG TRAINS POSSIBLE

Steel Castings Bring You These Advantages

1 Uniform structure, for greater strength, shock and stress resistance.

2 Metal distributed where it will do the most good; maximum strength with minimum weight.

3 Widest range of physical properties.

4 Good machining qualities, low finishing costs, better streamlined appearance.

5 High rigidity, minimum deflection, accurate alignment, close tolerances and better fit.

6 Readily weldable in composite structures.

7 High fatigue resistance, maximum endurance and longer life — ideal for critically stressed parts.

The railroad industry is one of the largest users of steel castings. Today, about 35% of the weight of a locomotive, and 16% to 18% of the modern freight car, is of this practical and economical material.

Cast steel parts have made better equipment less costly, and they have cut operating costs by saving weight and contributing strength and safety. They make mile long trains, running at increased speeds, economically practical.

In other industries, too, the use of steel castings is growing, because they provide great strength and toughness — great ability to resist shocks, strains and vibration — and often a saving in weight.

Whatever you make, steel castings will help you build a better product. Frequently they cost less than parts of other materials — they permit better weight distribution — they reduce finishing cost.

Why not discuss this subject with your local foundry? Or, if you prefer, consult Steel Founders' Society, 920 Midland Bldg., Cleveland. There is no obligation.

IMPROVE YOUR PRODUCT WITH

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YES, SIR-

it's an ACCURATE Spring

HERE is a flat wire spring that will have the mighty important job of keeping an automobile door closed. Slam! — Bang! — open and shut — thousands and thousands of times. Tough job? — sure but it's an Accurate Spring — built to take it!

You can almost tell that it is Accurate-made by simply looking at those perfect coils. But the most important features of an Accurate Spring you can't see! We mean — the research — the design and engineering — the precision manufacture—all the things that build the quality of Accurate Springs. Always insist upon those advantages. Send us your blue prints or ask to see an Accurate engineer.

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ACCURATE SPRING MFG. CO.
3813 W. Lake Street **Chicago, Ill.**

Heat Treating Cast Iron

(*Continued from Page* 53)

Annealing gray cast iron to decrease hardness and facilitate machining employs higher temperatures than those used in stress relieving treatments. Subjecting gray iron to temperatures ranging from 1250 to 1450 degrees Fahr. results in appreciable softening. Annealing is invariably accompanied by some degree of graphitization which is partly responsible for the resulting lower hardness.

Effects of Quenching

Effect of increasing the quenching temperature on the combined carbon content was determined on two cast irons, one a plain iron and the other a chrome-nickel-molybdenum iron. Samples were placed in a furnace already at the desired quenching temperature, held there for one hour, and then immediately quenched in oil. The results of hardness and carbon content determinations for the two irons are given in Table I.

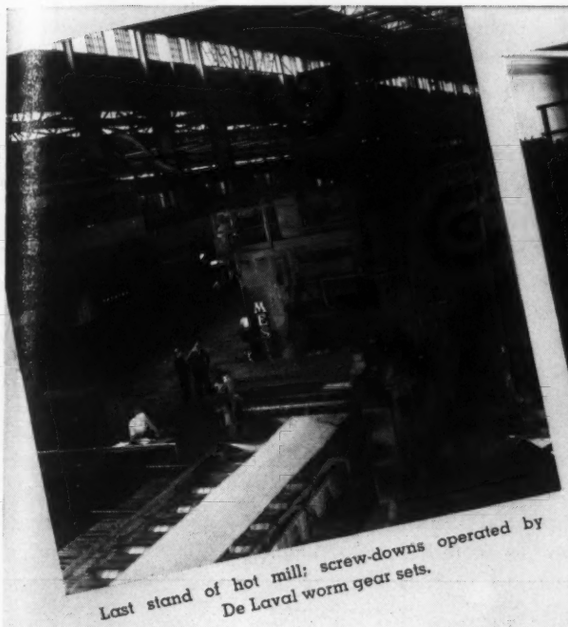
TABLE I

Results of Tests on Quenched Samples of Cast Iron

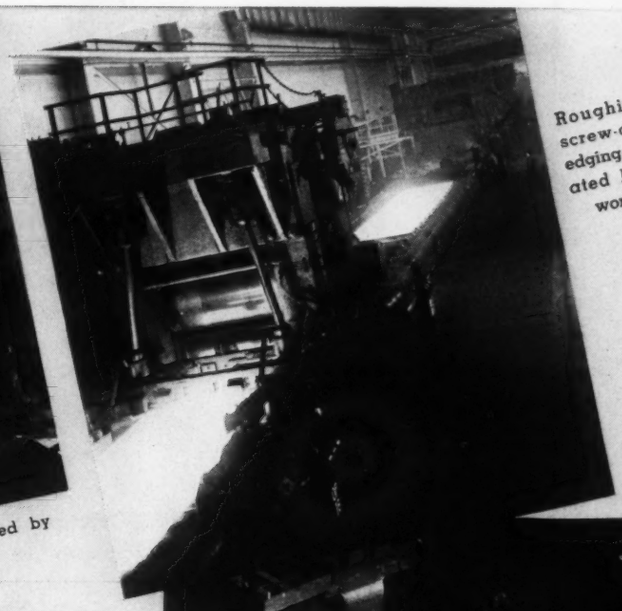
Quenching temp. deg. Fahr.	Plain cast iron		Cr-Ni-Mo cast iron	
	Combined carbon per cent	Brinell hardness	Combined carbon per cent	Brinell hardness
As cast	.69	217	.70	255
1200	.54	207	.65	250
1250	.38	187	.63	241
1300	.09	170	.59	229
1350	.09	143	.47	217
1400	Nil	137	.45	197
1450	.05	143	.42	207
1500	.47	269	.60	444
1550	.59	444	.69	514
1600	.67	477	.76	601

The structures as found in connection with the combined carbon content and brinell hardness support the notion that at temperatures in the neighborhood of 1250 degrees Fahr. graphitization begins and proceeds to completion if sufficient time is allowed at a rate dependent upon composition. These conditions were fulfilled in the case of the plain iron on a 1400 degrees Fahr. quench. In the case of the Cr-Ni-Mo iron, although graphitization was occurring, it was proceeding at such a slow rate at this same temperature that in one hour the combined carbon content had been reduced only to .45 per cent from .70 per cent. When the iron was heated to higher temperatures resolution of the graphite occurred in both irons, the structure of the matrix finally becoming fully martensitic upon liquid quenching. It appears that the hardening of cast iron by quenching is dependent to an important degree upon the amount of carbon which has been redissolved prior to the instant of quenching.

If the resolution of graphite is an important factor in the hardening of gray cast iron by quenching, some knowledge of the time involved in the process of graphitization and resolution of graphite during heating is essential to the understanding of the hard-



Last stand of hot mill; screw-downs operated by De Laval worm gear sets.



Roughing stand; screw-downs and edging rolls are operated by De Laval worm gear sets.

Six stands of hot finishing mill; screw-downs operated by De Laval worm gear sets.

MECHANICAL ACHIEVEMENT *demands* PERFECT DETAILS

The new 96-in. continuous strip mill, with rolling machinery built by the Mesta Machine Company, for the Pittsburgh Works of the Jones & Laughlin Steel Company, has a monthly capacity of 60,000 gross tons of steel. In this mill are incorporated the latest improvements for making the highest quality products. Tremendous pressures are required to roll some of the modern alloy steels, and the duty performed by the

DE LAVAL WORM GEAR SETS

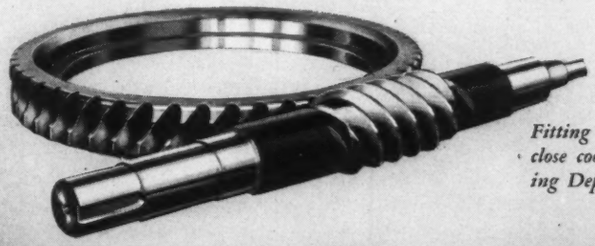
which actuate the screw-downs, and also the edging rolls of the roughing stand, is more severe than is encountered in most industries. These speed reducers are themselves products of a policy of high quality manufacture.

Their design is based upon reliable data obtained from laboratory tests and from years of field experience with a great variety of applications.

The materials used are bought under the control of thorough specifications and laboratory tests.

Machining is done on special tools to limit gages on an interchangeable basis and by special methods developed by De Laval experience extending back to 1901 in building high grade speed transformers.

Back of De Laval worm gears is a well established and reliable concern, having an unsurpassed record of making good in whatever it offers and promises to do.



Fitting of a De Laval worm gear drive to the user's problem is done by close cooperation with his designing engineers. The De Laval Engineering Department will gladly assist with data and advice in solving your speed transformation problems.

1106

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.

MANUFACTURERS OF STEAM TURBINES, PUMPS – CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT; CENTRIFUGAL BLOWERS AND COMPRESSORS; WORM GEARS; HELICAL GEARS; HYDRAULIC TURBINES AND FLEXIBLE COUPLINGS ••• SOLE LICENSEE OF THE BAUER-WACH EXHAUST TURBINE SYSTEM

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The machine tool market asks for more pieces per hour. The machine tool asks for higher speed and more automatic control. The machine designer asks for ideas.
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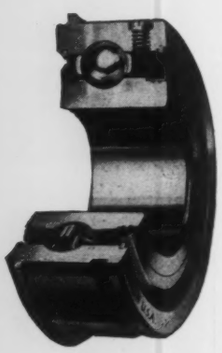

Made to Standard Double-Row Widths, with 100% Greater Grease Capacity.

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SIMPLIFY your design by eliminating supplementary outside closure parts and protective seals.

SAVE by cutting out many costly machining operations and extra parts, and by speeding up production.

PROTECT against the dirt hazard by the use of highly effective, wearless metal seals that positively exclude foreign matter and retain grease at any angle.

INSURE longer life and lower maintenance costs by providing 100% greater grease capacity; refilling plug and removable seals facilitate regreasing and inspection.

"NORMA-HOFFMANN"
NORMA-HOFFMANN BEARINGS CORPORATION
STAMFORD, CONN.

ening mechanism. The time factor may be all important in such practices as flame hardening which has become popular during the last four or five years.

It was decided to examine the flame hardening of irons to determine whether or not graphitization and resolution of graphite still controlled the hardening mechanism. Rockwell hardness determinations were made on concentric circles at various depths below the surface of each specimen. The average of ten readings on each circle for five irons is given in Table II.

Effects of Quenching and Drawing

The structures of samples were examined under the microscope. In the case of the plain iron a transition zone occurred wherein even with this most rapid heating and cooling operation graphitization had taken place. As would be expected, the alloy irons having slower graphitization rates did not show sub-surface layers of high ferrite content.

Graphitization of plain gray cast iron is exceedingly rapid. Relatively small additions of alloys have a marked effect in reducing the graphitization rate. The importance of reaching uniform temperatures well above the critical in treating plain gray cast irons is indicated.

With the foregoing assurance that the time involved in the usual heating and quenching cycle is decidedly longer than required to complete the graphite resolution cycle, a study of the physical property changes made possible by hardening and tempering gray cast iron was undertaken.

Quenching produced the following changes in the properties of the irons: (a) Brinell hardness was increased; (b) tensile strength was reduced; (c) transverse strength and deflection were reduced; (d) impact strength was reduced.

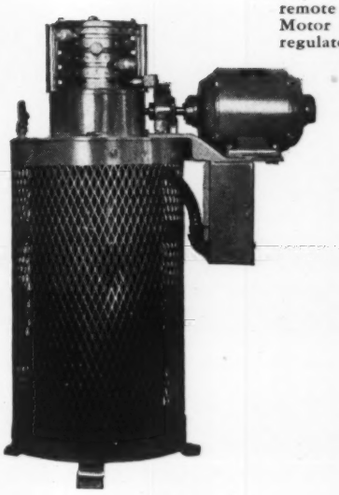
TABLE II

Rockwell C Hardness at Indicated Depths

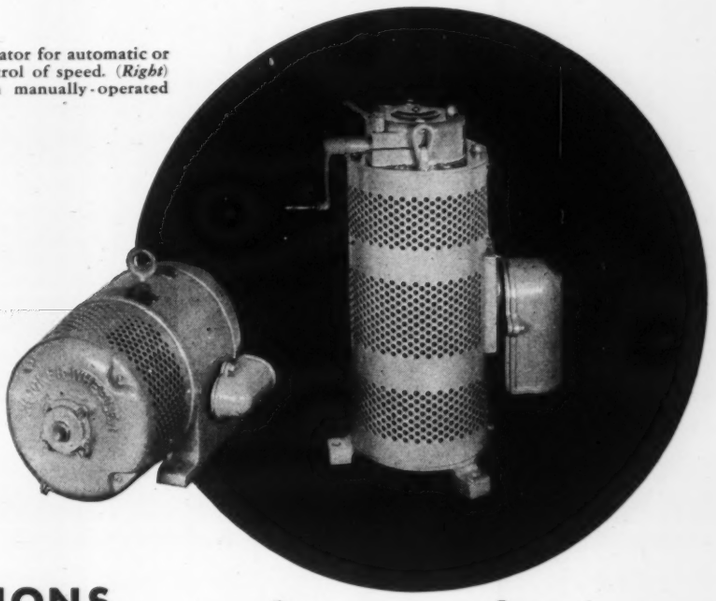
	Plain Iron	Mo	Ni-Mo	Cr-Mo	Cr-Ni-Mo
At surface	45	56	52	53	52
1/32-in. below surface	49	55	51	53	52
1/16-in. below surface	47	54	50	52	52
3/32-in. below surface	40	54	44	32 to 49	54
1/8 -in. below surface	20 to 39	50	40	18 to 32	53
5/32-in. below surface	20	30 to 48	19	18	52
7/32-in. below surface	18	18	19	18	31
9/16-in. below surface	16	18	19	18	17
At center	10	17	16	16	15

On drawing the quenched irons at successively higher temperatures, the following modification of properties resulted: (a) Brinell hardness gradually decreased; (b) tensile strength increased to a maximum at 800 to 1000 degrees Fahr. draw—at higher draws the tensile strength decreased from this maximum; (c) recovery of transverse strength and deflection values is realized, reaching but not materially exceeding the values "as cast"; (d) recovery of impact strength occurs, but this recovery does not bring about impact strengths as high as original "as cast" values.

Comparing properties after quench and draw treatments producing maximum strength, with the original



(*Left*) Regulator for automatic or remote control of speed. (*Right*) Motor with manually-operated regulator.



HERE ARE THE QUESTIONS MOST OFTEN ASKED ABOUT THE NEW A.C. polyspeed MOTOR

QUESTION: What is the *Polyspeed* Motor?

ANSWER: An alternating current adjustable speed motor designed for efficient regulation over a wide range of speed.

QUESTION: What does the motor do for me?

ANSWER: Solves your toughest adjustable speed problems on A.C. operation. Provides increased efficiency, increased production, and often—an improved product.

QUESTION: How does *Polyspeed* do this?

ANSWER: By providing the ideal speed for each operation; with *instantaneous* response to demands for higher or lower speed; with smooth starting—powerful, but non-jerking. High torque, if desired; no rheostat losses. With manual, remote or automatic control.

QUESTION: What is the speed range?

ANSWER: Full load speed range of the standard motor, for continuous operation, is from 1720 to 580 RPM. Any in-between speed is available. With a separate blower, the motor can operate continuously at speeds below 580 RPM. (down to slightly above standstill).

QUESTION: What sizes are available?

ANSWER: 1, 2, 3, 5 and 7½ HP. sizes, for operation on 220, 440 or 550 volts—3 or 2 phase, 60 cycle, circuits. Motors are rated on a constant torque basis. (A motor rated 3 HP. at 1720 RPM. will develop 1 HP. at 580 RPM.)

QUESTION: What kinds of drives are now using these motors?

ANSWER: Printing presses; knitting machines; hoists; paper-winders; centrifugal casting machines; fans; tubing machines; centrifugal pumps; testing and winding machines of many types—to name but a few.

Send for this New Bulletin

Write for free copy of Bulletin 251-A. Just off the press, it offers further information; describes and illustrates typical installations.

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POLYSPEED MOTORS
1 TO 7½ HP.

DIRECT CURRENT MOTORS
½ TO 5,000 HP.

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¼ TO 10,000 HP.

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FLEXIBLE COUPLINGS
UP TO 200 HP.

50 YEARS OF PIONEERING

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For "Close Quarters" Use
The Sturdy, High Capacity
MICRO SWITCH

LK LIMIT SWITCH

1—Movement Differential 0.001" or less.

2—Pretravel of actuator plunger to operating point, 0.010".

3—Overtravel of actuator plunger beyond operating point 1/32".

4—Distance between operating point and C. L. of 1/16" dowel pin holes held to ±.003".

3¼" x 1 13/16" x 1"

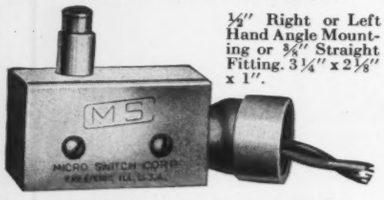
1/4" OVERTRAVEL METAL CLAD SWITCH

1—Movement differential under .0005".

2—Operating pressure about 8½ oz.

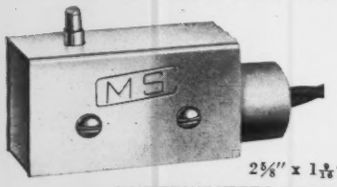
3—Overtravel of actuator plunger beyond operating point ¼".

4—Heater loads 1200 watts up to 600 volts A.C. Also inductive loads, solenoids, and relays, ½ H.P. up to 460 volts A.C. Same on all three switches shown here.



½" Right or Left Hand Angle Mounting or ¾" Straight Fitting. 3¼" x 2⅛" x 1".

1/16" OVERTRAVEL METAL CLAD SWITCH



1—Operates on 0.001" movement, 14 oz. pressure.

2—Can be used in any position—vibration-resistant.

3—60 or more snaps per minute. Millions of operations. Cut your costs and speed up production with these rugged, sure-acting MICRO SWITCHES.

2⅝" x 1 9/16" x 1 7/32"

UNDERWRITERS LABORATORIES LISTING

Write for specification sheet and recommendations covering *Micro Switch* applications. Samples supplied for trial tests.

MICRO SWITCH CORPORATION

13 EAST SPRING STREET, FREEPORT, ILL., U. S. A.

DID YOU TRY RAYMOND FOR THOSE SPRINGS?
Designing Springs for high temperatures, high speeds, to meet corrosive conditions . . . . these are jobs for the experienced springmaker. If you have problems in spring design, RAYMOND has the experience and engineering brains to solve them
RAYMOND SPRINGS
WIRE FORMS
STAMPINGS
RAYMOND MFG. CO., DIV. OF ASSOCIATED SPRING CORPORATION
280 SO. CENTRE ST. · CORRY, PENNSYLVANIA

"as cast" properties, the following are found: (a) Higher hardness; (b) higher tensile strength; (c) substantially the same transverse strength; (d) reduced deflection; (e) reduced impact strength.

Comparing quenched and drawn irons of the same (or approximately the same) brinell hardness as the "as cast" iron, the heat treated irons possess: (a) Higher strength; (b) slightly lower transverse strength; (c) lower deflection; (d) lower impact strength.

The response of all the irons to quench and draw treatments was qualitatively the same. A composite chart is given in *Fig.* 1 showing the general trend of hardness, tensile strength and impact strength as the draw temperature is varied.

Hardenability Parallels Steel

Hardenability specimens were placed in a furnace at 1575 degrees Fahr. and held there for one hour. At the end of this time each specimen was removed and quenched in a fixture so designed that only its bottom surface was sprayed with water. This produced a continuous series of cooling rates throughout the length of each specimen, from a rapid water quench at the bottom to an air cool at the top. Since size, quenching temperature, temperature of quenching medium, etc.

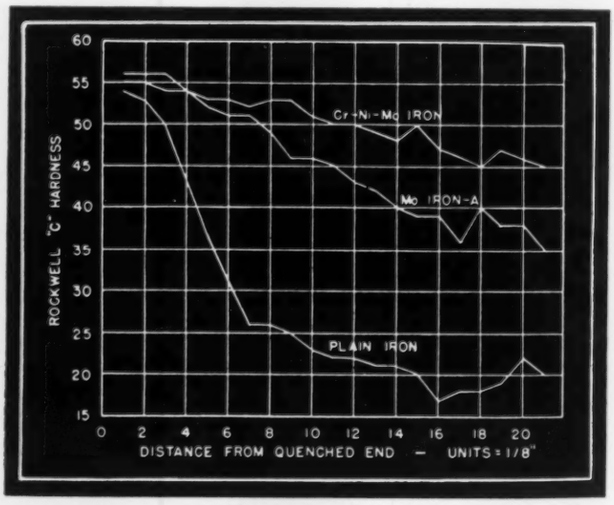


Fig. 2—Effect of alloy additions on hardenability of three irons. Variations in hardness throughout length were obtained by spraying end of iron with water

are constants for all specimens, the hardness for corresponding points on the specimens is a function of the analysis of the irons and a criterion of their respective abilities to harden according to a given cooling rate.

Points from three irons were plotted, producing the curves in *Fig.* 2. These results are interesting insofar as they show that the effect of alloys on the hardenability of cast iron parallels the effect in steel already widely accepted.

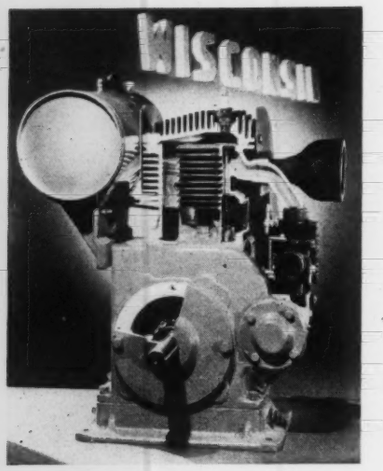
"Colfite"

FORMICA SELF-LUBRICATING, IMPREGNATED with GRAPHITE

FOR uses where a certain degree of self-lubrication will increase durability, Formica offers a special grade of graphite-impregnated stock known as "Colfite" . . . It has been found useful on breaker arms where it increased the life of the contact surface; on thrust washers used in automobile waterpumps where resistance to wear was desired and means were not available for thorough lubrication; for bearings used to supplant bronze in a rayon centrifuge, and for many similar uses . . . Where the non-oily slipperyness of graphite is desired in a part that is not brittle, will hold its dimensions, maintain a smooth surface under wear, "Colfite" may be the answer. Let us give you the facts.

The Formica Insulation Co., 4639 Spring Grove Ave., Cin'ti, O.

FORMICA



A reproduction of Model AD—3H.P. Air-cooled engine.

A complete line 1 to 30 H. P.

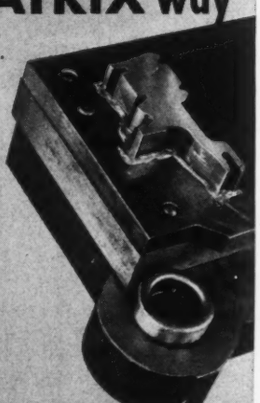
THE ALL-WEATHER ENGINE MUST BE AIR-COOLED

Your best insurance against trouble and expense no matter what weather conditions may be —

HEAVY DUTY AIR COOLED ENGINES by WISCONSIN MOTOR CORPORATION

WISCONSIN
MOTOR CORP., MILWAUKEE, WIS.

Save time, labor and mistakes —the CERROMATRIX way



Are you still locating punches in dies by costly "fitting and filing" methods? Are you still using drive fits in anchoring machine parts? Better look into the savings made in a great many shops with CERROMATRIX, the low-temperature-melting alloy that expands slightly on solidifying. For example, five ounces of Cerromatrix saved nine hours in locating the irregular punch in the blanking die shown here.

Photograph by courtesy of Ranco, Inc., Columbus, O.

Send for booklet

CERRO DE PASCO COPPER CORPORATION
44 WALL ST. NEW YORK, N. Y.

British Associates: MINING & CHEMICAL PRODUCTS LTD., London, England
Canadian Representatives: DOMINION MERCHANTS LTD., Montreal, Canada

MANUFACTURERS' *publications*

ALLOYS (BRONZE)—Riverside Metal Co., Riverside, N. J., has published a new booklet discussing the features and development of phosphor bronze and showing the various forms and analyses of Riverside alloys. Rules for ordering and using these bronzes are given and numerous photographs and conversion tables add usefulness to the publication.

ALLOYS (NICKEL)—Bulletin T-13, "Nickel and Nickel-Base Alloys," has been revised by The International Nickel Co. Inc., New York. Uses of these alloys in the design of corrosion-resistant machinery are discussed fully and are illustrated by a wealth of tables and photographs.

BEARINGS—Miniature ball bearings to provide properties of accurate alignment, long wear and freedom from attention for fine or delicate mechanisms are discussed in a booklet issued by Split Ballbearing Corp., Lebanon, N. H. Sizes are given along with notes on application of these bearings.

CHAINS—Over a third larger than its predecessor, catalog M has just been issued by The Baldwin-Duckworth Chain Corp., Springfield, Mass., listing and describing the company's complete line of single and multiple-strand roller chains, sprockets, chain attachments, etc. Profusely illustrated with application photographs, the catalog includes prices for the first time. Copies are available if requested on company letterhead.

FASTENINGS (SOCKET SCREWS)—Parker-Kalon Corp., 200 Varick street, New York, has issued a socket screw drafting room chart condensing in a form suitable for easy reference a large amount of data for users of socket screws.

FINISHES (PLASTIC)—A new 12-page booklet has been issued by Amercoat Sales Agency, 5905 Pacific boulevard, Huntington Park, Calif., describing the various types of cold-applied corrosion resistant plastic coatings made by American Concrete & Steel Pipe Co., Southgate, Calif. Present uses of these coatings are given, as well as application procedures.

LUBRICATION (GRAPHITE)—What happens to new bearings during the running-in period, how high spots are levelled "plastically," and this procedure's relation to colloidal graphite lubricants, is discussed in a technical bulletn No. 112.4 issued by Acheson Collods Corp., Port Huron, Mich. The bulletin contains

WORLD'S LARGEST

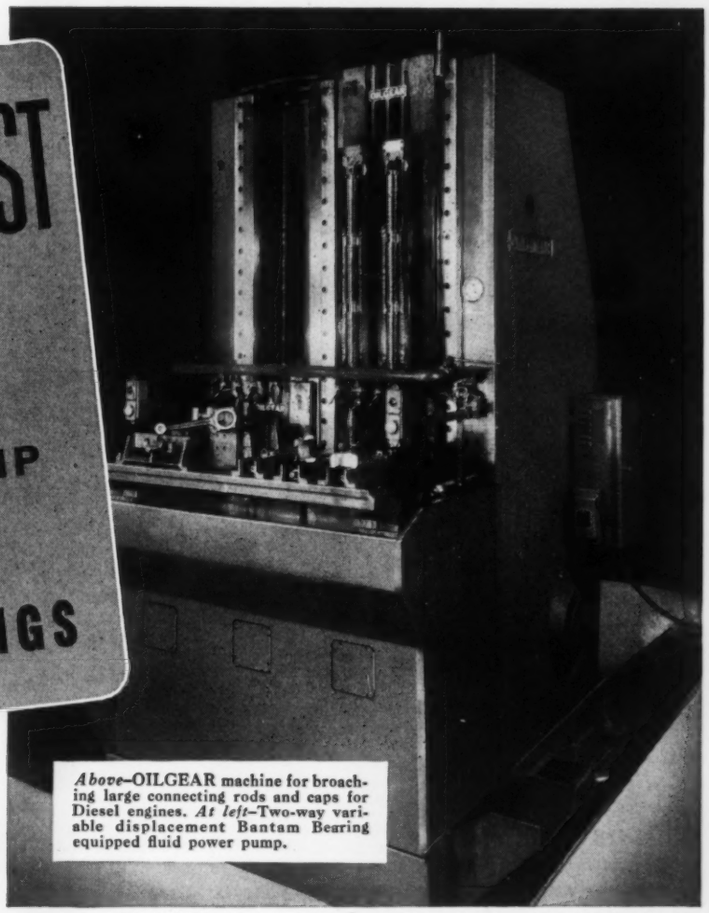
Powered By

OILGEAR

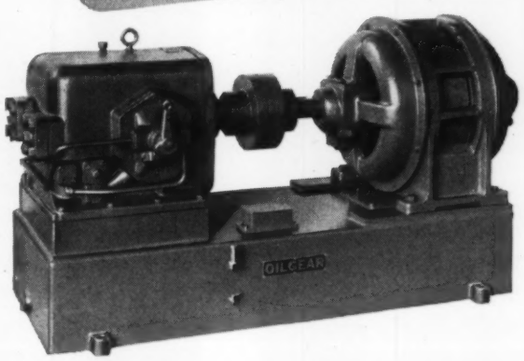
FLUID POWER PUMP

Equipped with

BANTAM BEARINGS



Above–OILGEAR machine for broaching large connecting rods and caps for Diesel engines. *At left*–Two-way variable displacement Bantam Bearing equipped fluid power pump.



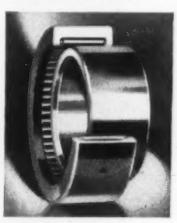
THIS giant machine, for broaching with precision accuracy large connecting rods and caps for Diesel engines, is believed to be the largest of its type ever built. It weighs nearly 30 tons; removes 100 pounds of metal and produces 50 completely finished rods and caps per hour. The smooth "fluid power" behind its 120,000 lbs. capacity depends on Bantam radial roller bearings, 13¾" O.D. and 9" O.D., for long life and dependable, trouble-free operation.

In the machines you *buy* and the machines you *build*, Bantam Bearings offer advantages which it will pay you to investigate.

BANTAM BEARINGS CORPORATION
SOUTH BEND, INDIANA
Subsidiary of THE TORRINGTON CO.
Torrington, Conn.

New Standard Series
QUILL BEARINGS
SHAFT SIZES 1/2" to 5"
CARRIED IN STOCK

Provide high load carrying capacity in limited areas . . . Easy to install . . . Low cost. Exclusive features include (A) One-piece channel-shaped outer race, (B) Specially designed curvilinear trunnions on rollers, (C) Improved method of roller retainment, (D) Simplified design with all fragile parts eliminated, (E) Supplied with or without hardened and ground inner race.



BANTAM BEARINGS

TAPERED ROLLER • • • STRAIGHT ROLLER • • • BALL BEARINGS

R.F.D.
goes
MODERN
The Leich Electric Company's new all-molded Magneto Telephone completes the modernization of the farm.
Leich chose plastics because of its easy adaptability to design, its durability and lasting beauty.
Leich also chose Chicago Molded Products to do the job.
Does your product need that last touch of up-to-dateness which plastics can provide? Our design and engineering staff will co-operate with you.
CHICAGO MOLDED PRODUCTS Corp.
1028 North Kolmar Ave. Chicago, Ill.

VICTOR
Super-Power
MOTORS
MODEL M41
MODEL M35
MODEL M6
SHADED POLE . . .
. . . Induction Type
Victor offers an outstanding line of quality-built motors of fractional power ranging from 1/200 to 1/10 H. P. Ideal for such applications as fans, blowers, animated displays, timing devices, etc. Years of successful motor building — equipped to solve difficult engineering problems. Write for literature today!
Manufacturers' Representatives:
A few territories not yet assigned.
If interested, write us at once.
VICTOR ELECTRIC PRODUCTS, INC.
3019 Robertson Avenue Cincinnati, Ohio

practical information for reducing wear in bearings.

PLUGS (ELECTRICAL)—The Pyle-National Co., 1334 North Kostner avenue, Chicago, has just issued bulletins Nos. 1140-1 and 1140-3, describing and illustrating its Triploc and general purpose plugs and receptacles for electrical equipment. Specifications and recommended uses are listed, as well as suggestions for application. Illustrations are generous.

PUMPS—Bulletin No. 74 has been issued by Pacific Pump Works, Huntington Park, Calif., describing high pressure boiler feed pumps and giving such information as design conditions, design features, and specifications for boiler feed service. Lavishly and tastefully illustrated, the bulletin also includes cross sectional diagrams and installation photographs.

STRIP HEATERS—Electric vane strip heaters for promoting convection of free air, heating air streams or heating liquids, are described in a folder published by Harold E. Trent Co., 618 North Fifty-fourth street, Philadelphia. Various charts, curves and pictures bring out the applications of these heaters.

STROBOSCOPES—Types 631-B and 648-A stroboscopes are discussed in a new illustrated leaflet published by General Radio Co., Cambridge, Mass. Action of the stroboscope is described and pictures and captions tell how the instrument is used.

THERMOMETER—Bulletin 4100 has been issued by Wheelco Instruments Co., 1929 South Halsted street, Chicago, describing the dial-indicating thermometer for use on dry kilns, ovens, preheaters, air ducts, etc., with mercury, gas-filled or vapor actuations.

TRANSFORMERS—Aircooled control transformers designed for applications requiring circuit insulation and also to provide voltage changes for the practical operation of domestic and industrial apparatus are described in a new leaflet, catalog section 75-030, issued by Westinghouse Electric & Mfg. Co., East Pittsburgh.

TURBINES—Turbine in the 100 to 200-horsepower range, manufactured for every type of industry using mechanical and electrical power, is described in new booklet B-2175 issued by the Westinghouse Electric & Mfg. Co., East Pittsburgh. Flexible in design, these turbines give 1000 to 5500 revolutions per minute, and are for steam pressures up to 650 pounds, steam temperatures to 750 degrees Fahr., exhaust pressures to 200 pounds, vacuum to 29 inches mercury and extraction pressures to 200 pounds.

CORRECTION: An error occurred in the caption for the blueprint on page 42 of the May issue in the article on paper machinery. As indicated in the text, the caption should have read *"Fig* 4.—Arrangement of single roll vacuum forming wet end."

Advertising Lowers Prices*

ARE you willing to spend 45 cents to save $15? Of course you are—if you know the facts. Sometimes advertising performs a miracle like that.

Ten years ago, a certain camera sold for $30. It was advertised extensively, sales increased, and overhead costs were reduced. Now, with larger production, the manufacturer is able to operate more economically and to sell a better camera for $15. The advertising cost amounts to 45 cents for each camera. The saving to the customer is $15.

In a similar way, advertising has helped to lower prices in many other specific cases. Yet there seems to be a common impression that advertising represents an extra cost, something that must be added to the price of what you buy.

Everybody knows that advertising costs money and that it is used to help sell goods. Less known is the fact that good advertising sells goods so well that it is the cheapest way of selling them. This is one of the reasons why it is possible to sell well-advertised goods at a lower price than if they were not advertised.

Then there is the other important reason. As advertising builds the sales volume of a company faster and greater than any other method, it makes large-scale manufacturing possible, and that reduces the cost of making each article. When there is competition, which there usually is, manufacturers and dealers lower their prices as rapidly as they can. In this way, consumers get the benefit of the savings that advertising effects in the costs of selling and manufacturing.

When you see thousands of dollars spent for a single advertisement or a single radio broadcast, it is only natural to assume that you have to pay for it when you buy the advertised article. But few people realize how little this cost really is when spread over the large number of units sold through the advertisement and how large a saving this makes in the total cost. On canned food, the average cost of advertising is less than one-half cent per can. On one of the most widely advertised soft drinks the advertising cost is less than one-fiftieth of a cent per glass!

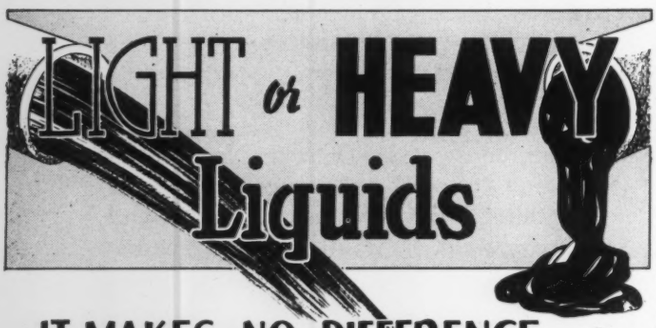
Lumping together all the advertising in the country, the total expenditures amount to less than 2 per cent of the value of all goods sold. This is very small in comparison with other selling and distributing costs. The Department of Commerce estimates that in 1935 the total cost of distribution was 28 per cent. So it appears that the total amount spent for advertising is only one-fourteenth of the whole cost of distribution.

If no money were spent for advertising, the cost of selling and distributing would be far higher than it is now, and prices would have to be higher. More important still, a smaller volume of goods would be sold and produced, and there would be less employment, and a smaller share of the world's goods for each of us. Advertising puts money in your pocket.

*PREPARED BY THE BUREAU OF RESEARCH AND EDUCATION, ADVERTISING FEDERATION OF AMERICA

—Advertisement

SELECT YOUR
POWER
— From the World's Finest Small 4-Cycle Air Cooled Gasoline Motors.
In Complete Range of Sizes and Models From ½ to 5 H.P.
Call on Briggs & Stratton for the best and most suitable gasoline motors for your requirements.
Whatever you need is available in standard and special types with a wide range of speeds and power output — special gear reduction drives, light weight models, direct mounting crank cases, etc. — Choose from Briggs & Stratton, the largest manufacturers of small gasoline motors in the world. Complete information on request.
BRIGGS & STRATTON CORP., Dept. MD-639
Milwaukee, Wis., U. S. A.
Also builders of Industrial Variable Speed Transmissions — Automotive Equipment — Automatic Air-Saver.
4 CYCLE
BRIGGS & STRATTON
GASOLINE MOTORS



IT MAKES NO DIFFERENCE . . . .

Regardless of whether the liquids you handle are highly volatile or extremely viscose, *Viking pumps them all* . . . efficiently and consistently.

It is only necessary that you instruct us as to what type of liquid you are pumping. If HEAVY, the pump is geared to a reduced speed and given extra running clearance. If LIGHT, full rated speed and standard running clearance is the answer.

The VIKING ROTARY "GEAR WITHIN A GEAR" PUMP handles ALL clean liquids, regardless of viscosity . . . and what's more, you'll find it a thrifty, willing worker. Write for Bulletin 1802-35.

There's a VIKING for every CLEAN LIQUID

VIKING PUMP COMPANY
CEDAR FALLS, IOWA

Business and Sales Briefs

INSTALLATION of facilities for production of heat-treated beryllium alloys in rod, strip and wire forms, in addition to the previously supplied master alloys in ingot and cast iron, has recently been completed by Beryllium Corp. of Pennsylvania, Reading, Pa.

♦

Kansas City Rubber & Belting Co., Kansas City, Mo., has been appointed sales representative in Kansas City area of Ohio Gear Co., Cleveland.

♦

In order to become assistant sales manager of Leland Electric Co., Dayton, O., E. C. Wickersham has resigned from the sales department of the Howell Electric Motor Co., Howell, Mich.

♦

Monsanto Chemical Co. has acquired Resinox Corp., third largest manufacturer of phenolic plastic molding compounds, with general offices in the Whitehall building, New York, and manufacturing plant and research laboratory at Edgewater, N. J. All personnel is being retained.

♦

A new field office located at 67 Wall street, New York, has recently been established by International Nickel Co. Inc. This office will be under the direction of J. W. Sands, and its primary function will be to assist in the application of nickel alloy steels and nickel cast irons.

♦

Appointment as sales representatives of A. H. Burnap, 940 Lancaster avenue, Syracuse, N. Y., and Eric N. Gilling, P. O. Box 4197, Pittsburgh, has been made by American Flexible Coupling Co., Erie, Pa. Mr. Burnap will cover central New York state, and Mr. Gilling western Pennsylvania and West Virginia.

♦

Having had considerable experience in the gear and power transmission field, A. R. Herbert has been named district manager of the newly-opened Chicago branch office of Philadelphia Gear Works. The new office is located at 111 West Washington street. Another appointment by the company is that of Roger C. Jones who has become a represenative in the lower New England territory, with headquarters in Hartford, Conn.

♦

Fred R. Cross, who has been connected with the Stewart-Warner Corp., Chicago, for the last 15 years, has recently been appointed sales manager for the Alemite retail sales division. Mr. Cross joined the

MEETING SPECIAL REQUIREMENTS
BELLOWS WITH SILVER-SOLDERED JOINTS FOR HIGH-TEMPERATURE WORK

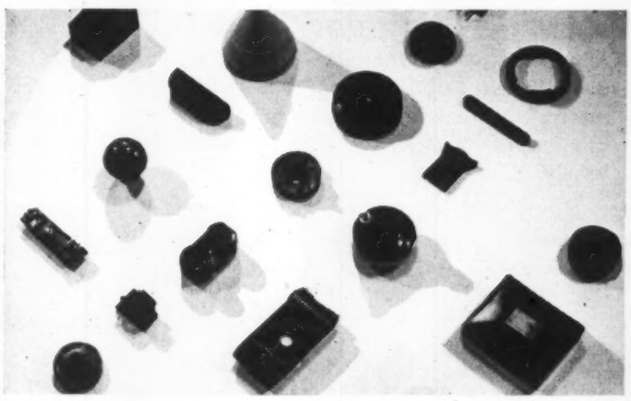
HYDRON

Metallic Bellows

HYDRON Metallic Bellows are used as control elements in temperature-and-pressure-control devices, and for liquid or gas seals of compressors and pumps. We are specialists in the design and production of complete thermostatic and pressure units for temperature and pressure controls. We are, therefore, prepared to extend the fullest co-operation to engineering departments of control manufacturers in the solution of design and engineering problems.

Write for 44 page ENGINEERS' DATA BOOK

CLIFFORD MANUFACTURING CO.
564 E. FIRST STREET, BOSTON
BOSTON CHICAGO DETROIT LOS ANGELES
PRODUCERS OF BELLOWS EXCLUSIVELY
SERVING AUTOMATIC CONTROL MANUFACTURERS



THAT MAKES EVERY MOLDED
Experience
JOB A BARGAIN

An Auburn bid on any plastic molding job, big or little, includes no premium for quality. Quality is there, but because of Auburn's long experience in handling all types of plastics and in molding a wide range of products, it comes as an integral part of every job.

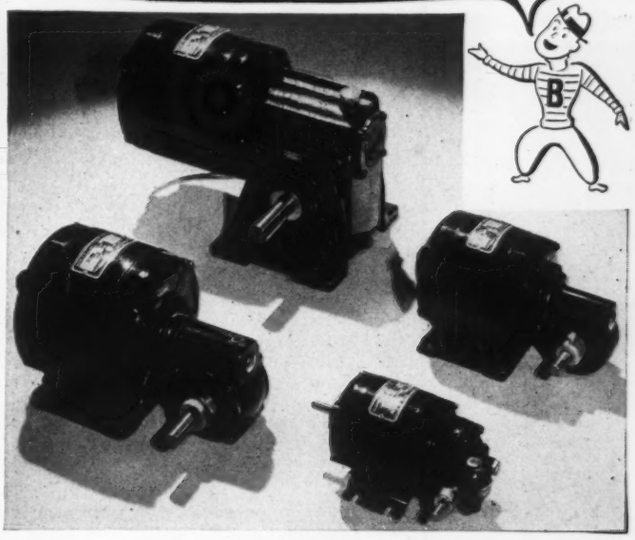
Auburn's cost-cutting, quality-insuring experience . . . the care and skill with which your dies are engineered . . . and the long series of inspections every product must pass, are your guarantees of a molded plastic job in which quality is outstanding, but in which price is often surprisingly low.

On your next molded plastic job . . . be sure to ask for an Auburn bid.

Established 1876

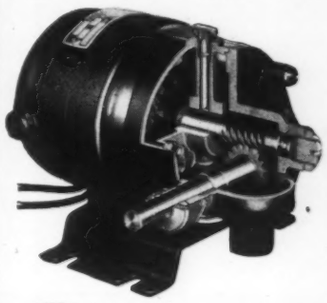
MOLDED PLASTICS DIVISION OF
AUBURN BUTTON WORKS, Inc.
AUBURN, N. Y.—New York, Chicago, Detroit, Cleveland, Rochester, Boston

Bodine has a SPEED REDUCER MOTOR to fit any machine!



More than 1600 Standard Types from 1/2000 to 1/6 hp

No other manufacturer can offer you so many standard fractional horsepower, speed reducer motors. Bodine built-in, speed reducer motors are available in shaded pole, series, synchronous, split phase, shunt, polyphase, capacitor, and governor types. They can be furnished with sleeve or ball bearings and with standard or special mountings. In addition, Bodine offers a complete line of fractional horsepower motors without speed reducers.



Bodine motors are reliable, smooth running, quiet, efficient, and long-lived. Investigate Bodine motors for your product.

MAIL COUPON FOR BULLETIN

BODINE

Bodine Electric Co., 2258 W. Ohio St., Chicago, Ill.
Please send me your new bulletin on speed reducer motors.
Name.....
Company.....
Address.....

BODINE MOTORS
ENGINEERED FOR YOUR PRODUCT

NO NOISE ABOUT IT

Write for Catalog on Reversing Pumps

Tuthill Automatic Reversing pumps keep busy doing a job no other pump can do. Regardless of direction of shaft rotation, these pumps deliver from the *same port—without the use of check valves.* This automatic feature alone assures a positive supply of pumpage regardless of direction of pump shaft rotation. Six sizes: ⅜" to 1½" pipe tap. Capacities up to 50 g. p. m.

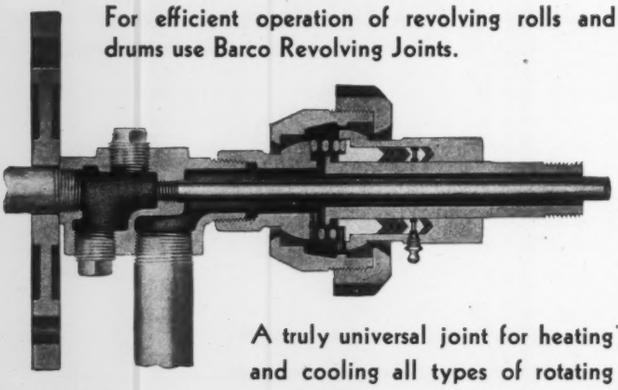
TUTHILL PUMP COMPANY

941 EAST 95th STREET • CHICAGO, ILLINOIS

BARCO

REVOLVING JOINTS

For efficient operation of revolving rolls and drums use Barco Revolving Joints.



A truly universal joint for heating and cooling all types of rotating rolls. Eliminates packing troubles due to strains in ordinary stuffing boxes.

Barco Manufacturing Co.

1820 Winnemac Avenue

CHICAGO, ILL.

In Canada: The Holden Co., Ltd.

company as advertising manager in 1924. Additional personnel changes in this division are: A. F. Haberl Jr. has been appointed assistant Alemite retail sales manager with headquarters in Chicago. L. A. Ballard, previously assistant to the sales manager, has been named Alemite distributor for Boston.

♦

According to a recent announcement by F. A. Brodeur, general manager of U. S. Plastic Corp., Leominster, Mass., I. J. Zellen has resigned as an officer and director of the company, his duties now being taken over by J. Franklin Millea.

♦

A new plant has been opened by United American Metals Corp. in San Francisco for the manufacture of babbitt metal and bushing bronze. This new plant will supplement the others in Brooklyn, N. Y., Chicago and Baltimore, and is equipped with specially constructed furnaces for alloying by the Stanley process.

♦

Quality Steels Co., Dayton, O., and Pittsburgh Gage and Supply Co., Pittsburgh, have been made distributors of Crucible Steel Co. of America, manufacturers of machinery steels. Another appointment is that of W. E. Gardner who has been named manager of the Boston branch, 135 Binney street, Cambridge, Mass., succeeding W. P. Knecht, recently transferred as manager to the London, England office.

♦

Harlan M. Gale, formerly connected with Cleveland Varnish Co., and Glidden Co., has been named a sales representative for the New England territory for Maas & Waldstein Co., Newark, N. J. W. C. Treadwell, formerly New England representative, is now covering upper New York state with headquarters at Rochester, N. Y.

♦

Temporary factory offices have been opened at 81 San Miguel street, Springfield, Mass., by Sterling Electric Motors Inc., Los Angeles, to take care of an increasing amount of business in the Eastern territory.

♦

J. H. Critchett has been elected president of Electro Metallurgical Co., New York. Mr. Critchett was formerly vice president.

♦

Rollway Bearing Co. Inc., Syracuse, N. Y., has as its new president H. Follette Hodgkins who has taken over the general managership of the company replacing W. H. Float, recently resigned.

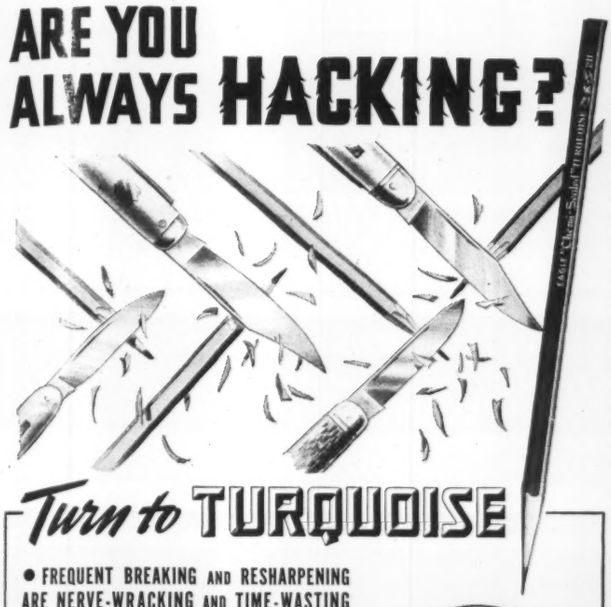
♦

Consolidation of its executive offices, previously located in New York city, with its works at Bethlehem, Pa., has recently been made by Roller-Smith Co., makers of electrical instruments and circuit breakers.

♦

H. M. Francis, who has been associated with American Steel & Wire Co. for 23 years, having entered as

ARE YOU ALWAYS HACKING?



Turn to TURQUOISE

● FREQUENT BREAKING AND RESHARPENING ARE NERVE-WRACKING AND TIME-WASTING

. . but easy to avoid. Try these tests:

Note how a "Chemi-Sealed" TURQUOISE point stands up under pressure. Eagle's patented super bonding process saves many resharpenings by joining lead and wood inseparably to combine their strength against breakage. ¶ Note how long a TURQUOISE holds its point. Super-refined ingredients, compacted under sixty tons pressure and fired at white heat, form a dense, uniform lead structure that wears down very slowly.

EAGLE "Chemi-Sealed" (SUPER BONDED) TURQUOISE DRAWING PENCILS *REG. U. S. PAT. OFF.

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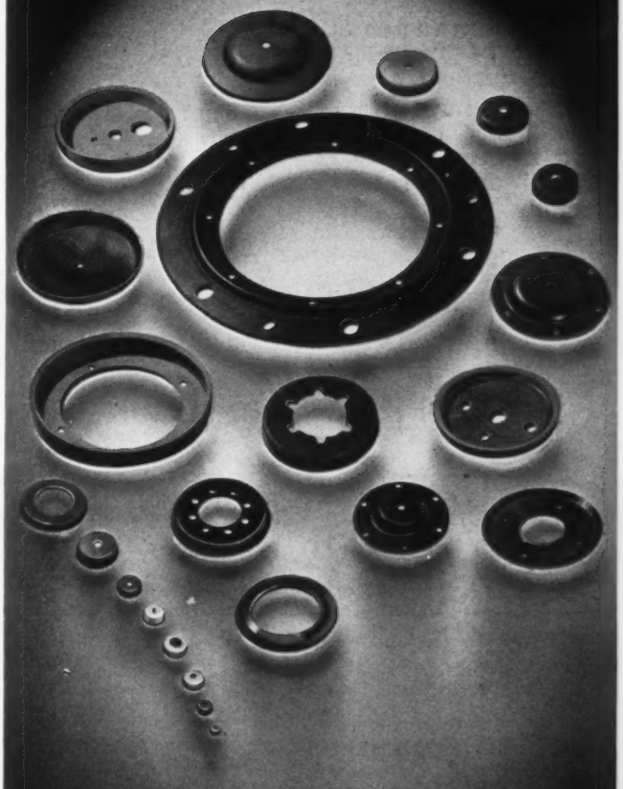
use LEATHER for PACKINGS



Use leather because leather is an ideal packing material. The tough, resilient, fibrous structure of mechanically tanned leather is treated, impregnated, lubricated, molded or hardened to meet the specific conditions under which the packing is to be used. Chicago Rawhide Engineers are experienced in producing leathers to pack perfectly under specific operating conditions sealing air, water, oil and other gases or fluids at pressures varying from a few pounds to several thousand pounds.

Backed by over 50 years of specialization in the selection, tannage, treatment and fabrication of LEATHER for mechanical use, C/R Packings will exactly meet your requirements and will give long trouble-free service.

If faced with a packing problem call on the C/R Technical Experts—their service obligates you in no way.

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1305 Elston Ave., Chicago, U. S. A.

POSITIONS

AVAILABLE OR WANTED

WANTED: Sales Engineers or manufacturers' agents in several large industrial centers to represent an old-established company producing machine parts sold to machinery manufacturers. Must be technically trained. Give particulars as to lines handled and territory now covered. Address Box 117, MACHINE DESIGN, Penton Building, Cleveland, Ohio.

CLASSIFIED advertisements are set in eight point Stymie bold face type, approximately eight words to a line. Rates are as follows:

Positions Available—20c a word, with a minimum charge of $10.00, which permits the use of fifty words.

Positions Wanted—10c a word, with a minimum charge of $3.00, which permits the use of thirty words.

The box number will be counted as one line or eight words.

.... *Two New*
Centrifugal Motorpumps

Compact — Modern — Flexible in Installation —
for Supplying Coolant
or for light transfer work
Can be mounted either horizontally or vertically.
No. 240 has flange mounting integral with pump - - - - eliminating inlet piping.

Write for Pump Catalog
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BROWN & SHARPE PUMPS

Gear Specialties

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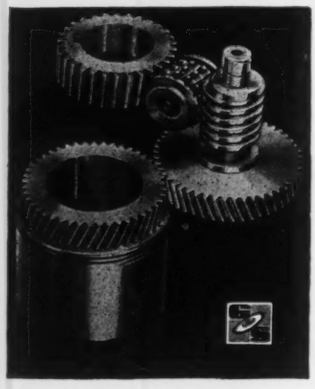
SPURS
SPIRALS
HELICALS
BEVELS



14 to 96 D.P.

RACKS
RATCHETS
WORM-GEARING

—such as these, and numerous others, are the logical product of a skilled organization with a deft 'feel' for *precise* work . . . Note the *Combination* Worm-gear, rotating as a Gear on one side and as a Worm on the opposite side.

Made to order only — No stock — No catalog

Gear Specialties
INCORPORATED
CHICAGO

2670 W. MEDILL AVE. PHONE HUMBOLDT 3482

a messenger in the New York office of the company, has now become assistant vice president in charge of sales, with headquarters in Cleveland. He previously was assistant general manager of sales.

♦

Erection of a new mechanical rubber goods factory of the B. F. Goodrich Co., to be located at Clarksville, Tenn., will be commenced in the autumn.

♦

For the past eight years sales manager of the Insulating division, Corning Glass Works, Corning, N. Y., W. H. Taubert has joined Phelps Dodge Copper Products Corp. sales department, New York.

♦

Previously assistant manager of sales of the alloy steel division of Republic Steel Corp., at Massillon, O., George F. Hess has been appointed district sales manager of the Houston, Tex., district.

♦

Ward Leonard Electric Co. has recently appointed C. B. Rogers as their representative in the states of Georgia, South Carolina and North Carolina for the sale of the company's line of electric control devices. Mr. Rogers' headquarters are at Zahner building, 1000 Peachtree street, Northeast, Atlanta, Ga.

♦

Formerly acting as manager of the Chicago office of Robbins Conveying Belt Co., New York, R. W. Eichenberger, vice president, has been transferred to the New York office at 15 Park Row where he will collaborate in general sales management for the company with H. Von Thaden, vice president.

♦

J. R. Kumer, former Pittsburgh district sales manager of Allegheny Ludlum Steel Corp., will replace Howard M. Givens Jr. as assistant manager of sales, stainless bar and wire products division. Mr. Kumer's duties in turn will be assumed by R. S. Ahlbrandt.

♦

Baldwin-Duckworth Chain Corp., Springfield, Mass., has established new warerooms, sales and engineering offices at 276 Canal street, New York City, with K. B. Brandenburg in charge. Mr. Brandenburg was transferred from the company's Detroit office. F. T. Lange will replace him at the Detroit office, located at 2-165 General Motors building.

♦

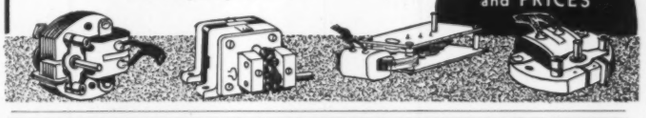
According to a recent announcement by C. Donald Dallas, president of Revere Copper & Brass Inc., C. H. Kuthe will act as technical advisor to the company's Michigan division. Charles W. Thomas is vice president and general manager of the Michigan divsion with headquarters at 5851 West Jefferson avenue, Detroit, and will operate directly with Mr. Kuthe and W. W. Roach, indusrial sales manager.

Low Cost made possible by improved designs, large quantity production and production methods . . . Dependability developed thru hundreds of different applications in the field . . . Stamina built-in for continuous operation and . . . . . High torque developed thru integral back gearing . . . . Cased or skeleton types with standard gears that give "any" speed, that save engineering, cost, and space of requirements of auxiliary speed reducing means . . . . Single drives, double drives—from top, bottom, right or left. Miniature motors for a hundred uses; motors that make *automatic* tuning, *automatic* opening and closing, automatic features that make sales at incidental costs.

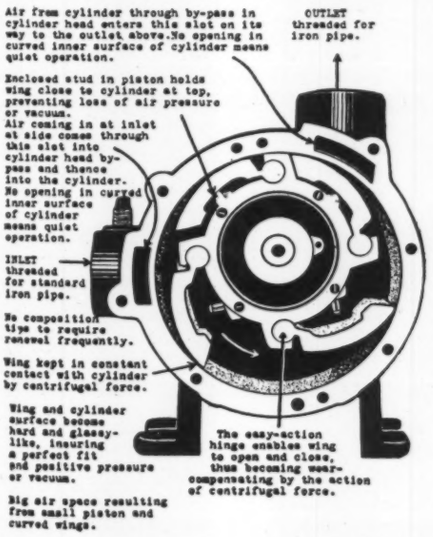
Sold singly, in dozens, thousands or millions.

SPEEDWAY MFG. CO.
1858 S. 52nd Ave.
Cicero, Ill., U. S. A.

WRITE for SPECIFICATIONS and PRICES



Standard Equipment on all sorts of Air Using Devices and used by the world's leaders . . . . .


Air from cylinder through by-pass in cylinder head enters this slot on its way to the outlet above. No opening in curved inner surface of cylinder means quiet operation.
OUTLET threaded for iron pipe.
Enclosed stud in piston holds wing close to cylinder at top, preventing loss of air pressure or vacuum.
Air coming in at inlet at side comes through this slot into cylinder head by-pass and thence into the cylinder. No opening in curved inner surface of cylinder means quiet operation.
INLET threaded for standard iron pipe.
No composition tips to require renewal frequently.
Wing kept in constant contact with cylinder by centrifugal force.
Wing and cylinder surface become hard and glassy-like, insuring a perfect fit and positive pressure or vacuum.
Big air space resulting from small piston and curved wings.
The easy-action hinge enables wing to open and close, thus becoming wear-compensating by the action of centrifugal force.

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PATENTED ROTARY AIR PUMPS
PRESSURE
VACUUM
for use with
GAS AND OIL BURNERS

PAPER FEEDERS
Bottle Fillers
GAS MACHINES
AUTOMATIC DEVICES
MANY SIZES

A Machine That Takes Up Its Own Wear Automatically

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MAKERS OF GOOD MACHINERY FOR 50 YEARS

MACHINES . . .

of all types and sizes are designed by readers of Machine Design.

This field embodies:

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Addressing & mailing machines
Agricultural machinery
Air conditioning equipment
Aircraft (airplanes, seaplanes & amphibians)
Automobiles (see Motor Vehicles)
Bakery machinery & equipment
Baling presses
Blowers & fans
Blueprinting & drafting machines
Bookbinding machinery
Bottling machinery
Calculating & counting machines
Cameras (including motion picture) & projectors
Canning machinery
Card-punching, sorting & tabulating machines
Cars & trucks, industrial & mining
Cash registers
Cement & concrete machinery
Centrifuges—separators
Change-making machines, taxi meters and ticket-counting machines
Check-writing machines
Chemical machinery
Clay-working machinery, brick, pottery, etc.
Clocks, time recorders & watches
Clothes-pressing machines
Coffee-roasting & grinding machines
Coin-operated machines
Condensers, other than electrical
Confectionery & ice-cream machinery
Conveying machinery including elevators and escalators
Cotton ginning machinery
Cranes, including hoists & derricks
Crushing, grinding & pulverizing machinery
Dairy, cheese factory & butter factory machinery
Dental machinery
Diesel engines
Dish-washing machinery
Dredging & excavating machinery including power shovels
Duplicating machines
Electric motors & generators
Electric & pneumatic portable tools
Electric razors and hair clippers
Electrical equipment (instruments, controls, relays, etc.)
Elevators (storage) & elevator machinery, including grain, flour & feed
Engines, steam & internal combustion
Fare registers & boxes
Firearms
Flour-mill & grain-mill machinery
Foundry machinery
Gas machines
Gas regulators
Glass-making machinery
Grinding, buffing & polishing mchy.
Hat-making machinery
Hydraulic equipment, incl. pumps
Incandescent lamp-making machinery
Industrial ovens & electric furnaces
Inspection machinery
Kitchen mixers & allied domestic machines not otherwise classified
Labelling machinery
Laundry and dry cleaning machinery
Lawn mowers
Leather-working machinery not including shoe machinery
Locomotives, rail cars, etc.
Lubricating machines
Machine tools
Metalworking machinery
Meters, gas & water
Mining machinery, not incl. oil drilling
Miscellaneous (not classified elsewhere)
Motorcycles & bicycles
Motor vehicles, except motorcycles
Musical instruments
Oil burning equipment
Oil-mill machinery, cottonseed & other
Oil-well & oil refinery machinery
Optical machinery incl. telescopes, microscopes, etc.
Orecrushers
Packaging machines
Packing-house machinery
Paint making machinery
Paper-box machinery
Paper-mill & pulp-mill machinery
Permanent wave machines, hair-dryers, etc.
Pharmaceutical machinery
Photo-engraving machinery
Plastics molding machinery, including presses & accessory equipment
Pneumatic equipment, including compressors
Power presses, including hydraulic & forging hammers
Printers' machinery
Pumps & pumping equipment
Radios & television
Recording and control instruments, including pressure & temperature indicators
Refrigerating & ice machinery
Research equipment, including testing, balancing & precision measuring machines
Road-making machinery, other than concrete mixers
Rolling-mill machinery
Rubber working machinery
Scales & balances
Sewing machines
Ships & motorboats
Shoe machinery
Signs, advertising & electrical
Slicing machinery
Special machinery
Stapling & wire stitching machinery
Stokers, domestic & industrial
Stone-working machinery
Sugar-mill machinery
Textile machinery
Tobacco manufacturing machinery
Toys, amusement machines & playground equipment
Transmission machinery
Turbines
Typewriters
Vacuum cleaners
Washing machines & clothes wringers
Welding machines, electric & other
Well-drilling machinery
Windmills & towers
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MACHINE DESIGN

The Professional Journal of
Chief Engineers and Designers

Scientific Test of Set of Helical Gears for Back Lash and Running Trueness

● **The D.O.James Testing Department, having the very latest scientific equipment and staffed with experienced gear men has the necessary "know-how" to insure that the finished product has the accuracies of the intended design.**

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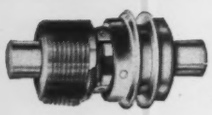
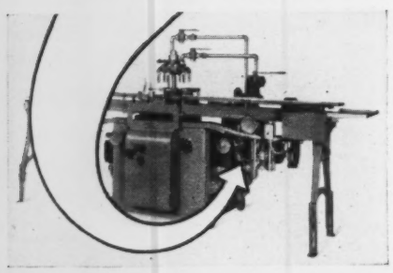
MAKERS OF ALL TYPES OF GEARS AND GEAR REDUCERS

PULLMORE CLUTCHES



Pullmore Clutches are made in single and double types for operation in oil or dry, in capacities from 1 h.p. to 75 h.p. at 500 r.p.m.

Selected for the New KIEFER FILLING MACHINE



Pullmore Clutches provide the smooth, dependable power transmission control required by high-production equipment. So a No. 2 Pullmore, of dry single type, was specified for the new Kiefer Two-Stream Vario-Visco Filling Machine. The Pullmore Clutch gives instant power application and release without slip or jar. It's durable, easy to operate and adjust, compact, simple to incorporate in a machine. On either main or auxiliary drives it is unexcelled. Write today for the Pullmore Blue Book which shows many typical installations, gives full descriptive information.

For internal combustion engine drives, investigate Rockford O-C (Over-Center) and Spring-Loaded Clutches. Full information on request.

ROCKFORD DRILLING MACHINE DIVISION

Borg-Warner Corporation, 304 Catherine Street, Rockford, Illinois

Sold by MORSE CHAIN CO., Ithaca, N. Y. With offices in principal cities

NEW MACHINES—

And the Companies Behind Them

(For illustrations of other outstanding machinery see Pages 54-55)

Food

Automatic fish-filleting machine, Atlantic Coast Fisheries Co., New York.
Ingredient mixer, Abbe Engineering Co., New York.
Centrifugal pump, Lawrence Pump & Engine Co., Lawrence, Mass.
Automatic doughnut machine, Peerless Brands Inc., Philadelphia.
Bagger, Akron Equipment Co., Akron, O.

Laboratory

Specimen dryer, Harry W. Dietert Co., Detroit, Mich.

Materials Handling

Portable shop crane, Barrett-Cravens Co., Chicago.
Truck with hydraulic elevating table, Lyon Iron Works, Greene, N. Y.
Twin-Motor tractor, The Gear Grinding Machine Co., Detroit.

Metalworking

Lockforming machine, The Lockformer Co., Chicago.
High-speed metal cutting band saw, Tannewitz Works, Grand Rapids, Mich.
Speed lathe, The Schauer Machine Co., Cincinnati.
Heavy precision boring machine, The Heald Machine Co., Worcester, Mass.
Bar stock machine, The Billings & Spencer Co., Hartford, Conn.
Internal honing machine, The Barnes Drill Co., Rockford, Ill.
Grinding and lapping machine, T.C.M. Mfg. Co., Harrison, N. J.
Dynamic balancing machine, The Globe Tool & Engineering Co., Dayton, O.
Coil cradle reel, F. J. Littell Machine Co., Chicago.
Hydraulic bending machine, Wallace Supplies Mfg. Co., Chicago.
Plain grinding machine, Brown & Sharpe Mfg. Co., Providence, R. I.
Wet drill grinders, The Hisey-Wolf Machine Co., Cincinnati.
Lathe, Sheldon Machine Co., Chicago.
Turret lathes, Gisholt Machine Co., Madison, Wis.
Throatless shear and flanger, The Quickwork Co., Chicago.

Milling

Fanning mill, American Grain Separator Co., Minneapolis.

Office

Desk dictating machine, Edison Laboratories, W. Orange, N. J.
Decimal machines for calculating sterling, Allen Calculators Inc., New York.
Stencil duplicator, Duplicator Corp., Minneapolis.
Adding machine-cash register, American Writing Machine Co., New York
Liquid duplicator, Keen Mfg. Co., Chicago.
Photo-copy machine, Remington Rand Inc., Buffalo, N. Y.

Packaging

Vacuum sealing machine, White Cap Co., New York.
Scroll press, Cameron Can Machinery Co., Chicago.
Heavy-duty folding carton gluer, E. G. Staude Mfg. Co., St. Paul, Minn.
Paper cup, filling, capping and dispensing machine, Anderson Bros. Mfg., Chicago.
Packaging machine, J. L. Ferguson Co., Joliet, Ill.

Printing

Plate matching machine, Goss Printing Press Co., Chicago.

Refrigeration

Multi-cylinder ammonia compressor, York Ice Machinery Corp., York, Pa.

Restaurant

Hoot food wells, Wells Mfg. Co., San Francisco.
Automatic electric counter fryer, Wells Mfg. Co., San Francisco.
Roto-glass washer, Liquid Carbonic Corp., Chicago.

Road

Motor pickup sweeper for gutter lane, Frank G. Hough Co., Chicago.
Electric heater for pavers, The Foote Co. Inc., Nunda, N. Y.
Paving breaker, Ingersoll-Rand Co., New York.
Vibrator, Concrete Equipment Manufacturers, Chicago.
Sidewall drills, Paris Mfg. Co., Paris, Ill.
Fire-fighting truck, Cardox Corp., Chicago.
Scraper, L. G. Le Tourneau Inc., Peoria, Ill.

Textile

Filling winder, Atkinson Hasericks & Co., Boston.
Multiple-feed knitting machine, Wildman Mfg. Co., Norristown, Pa.
Measuring and examining machine, Hermas Machine Co. Inc., Hawthorne, N. J.
Thread waste cutter, Taylor-Stiles & Co., Riegelsville, N. J.
Compensation and disk quiller tension machine, Silk City Metals Coating Co. Inc., Paterson, N. J.
Steamer for knitgoods, Knitting Machine Co., New York.
Full width reaming machine, Robert Reiner Inc., Weehawken, N. J.

. . only a

Hummingbird

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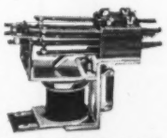
No larger than this tiny master of the air—small **Relays by Guardian** possess surprising ability to overcome many perplexing design and assembly problems, where like the big-bodied eagle . . . bulky electrical controls and mechanical methods become too involved, too power-consuming, too awkward and slow to compete with the compact efficiency of **Relays by Guardian.**



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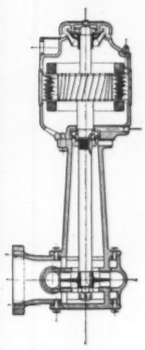
Machine designers are using more and more Gushers. The reason? Gushers are the pumps of tomorrow—simple in construction and easy to apply.

Gusher ball-bearing pumps are quiet, have split-second control and are designed to handle materials that contain grit and abrasives.

Pipeless Gushers will beautify your machines as well as end all your coolant problems.



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Patented and Patents Pending

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USE "GUSHERS"

Write for Engineering Specifications

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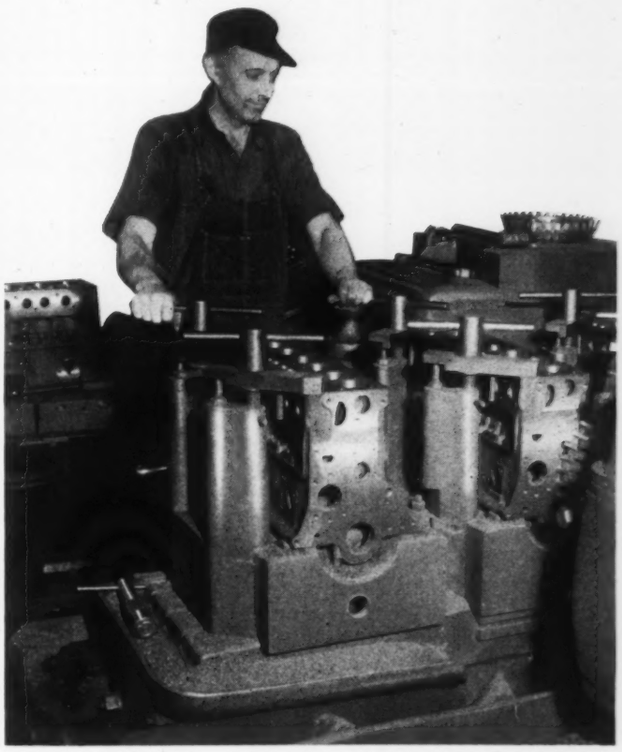
A new avenue of approach on tough design problems



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Then turn to Oilgear Fluid Power . . . which may quite likely be the opening to a vista of untouched design possibilities so rich as to be just the tool you have been looking for.

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Don't compare or limit Oilgear Fluid Power in terms of conventional means. The big, vital factor about Oilgear is its APPLICABILITY. THE OILGEAR COMPANY, 1321 W. Bruce St., Milwaukee, Wis.

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Fluid Power

VARIABLE SPEED SYSTEMS

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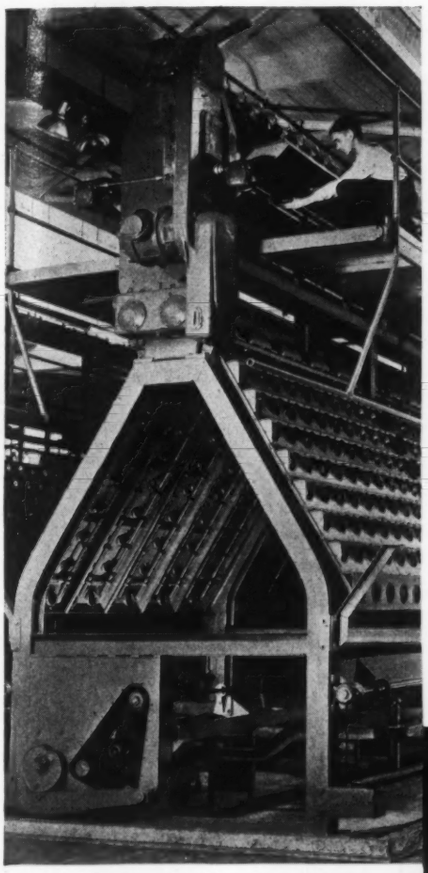
*Advertisements appear in previous issues.

All-Welded, Rolled Steel Construction Makes *Miracle Machine* Possible!



Set-up of the all-welded structural frames for the continuous spinning process machine units—operator's walkway at the process panel level not yet installed, but its supporting brackets are in place. Each unit has an individual motor drive and is composed of 5 intermediate A-frames, one end-drive A-frame with machinery box, 10 process panels, spin frames, spin transmission beams, machinery brackets and various other miscellaneous structural parts.

Here's the heart of the newest, most revolutionary production cycle the viscose rayon industry has seen in years. A close-up view of the stepped process panel showing pressed steel cups welded to the inclined skin plate. These cups, counterbored to a tolerance of .001 inch diametrically and held to a close vertical alignment and parallelism, act as retainers for flanged bearings supporting the process reels. Accuracy, rigidity and perfect alignment of the hundreds of moving parts on the panel were obtained through an unusual job of jig welding.

Sets new standards of precision . . . at approximately half the cost of previous methods of construction

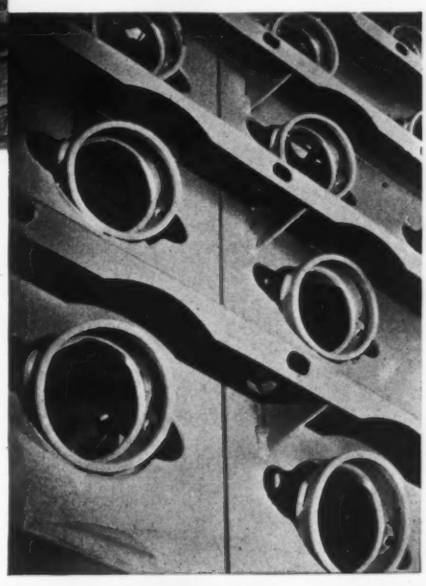
THEY said it couldn't be done. But here it is! The world's first commercial installation for the continuous spinning, processing, drying and twisting of viscose rayon yarn in one machine. 96 of these machines were installed in the new Painesville, Ohio, Plant of the Industrial Rayon Corporation. They will eliminate handling and interruptions, and produce a higher quality, uniform yarn more economically than ever before.

And all-welded construction with U·S·S Rolled Steel made it economically possible! Rolled steel construction effected a large reduction in weight . . . and a clean-cut structure devoid of complicating details and multiplicity of small parts.

The structural steel frames for these machines were fabricated by American Bridge Company. Each of the 96 units is 10 ft. 1 in. wide, 45 ft. 1 in. long and about 19 ft. high. Not merely the quantity involved, but the extreme accuracy required to assure perfect alignment needed constituted a problem which was economically solved by a resourceful, efficient combination of welding and U·S·S rolled shapes.

This revolutionary use of rolled steel construction opens a new realm of possibility for the fabrication and design of industrial equipment. From the experience gained on this contract, it is believed that many types of machine frames and supports, hitherto thought impractical to fabricate by welding, may now be undertaken with confidence.

We offer special steels in widest range. And our experience in putting these steels to work is yours for the asking. Investigate the economies, the added life, the strength, and speed of fabrication that rolled steels can give to equipment you fabricate.



Here are a few of the variety of special steels with special properties to overcome destructive forces in your rolled steel construction:

U·S·S HIGH TENSILE STEELS
to carry high unit stresses and to reduce weight to a minimum at low cost.

U·S·S ABRASION RESISTING STEELS
to reduce wear and cut replacements.

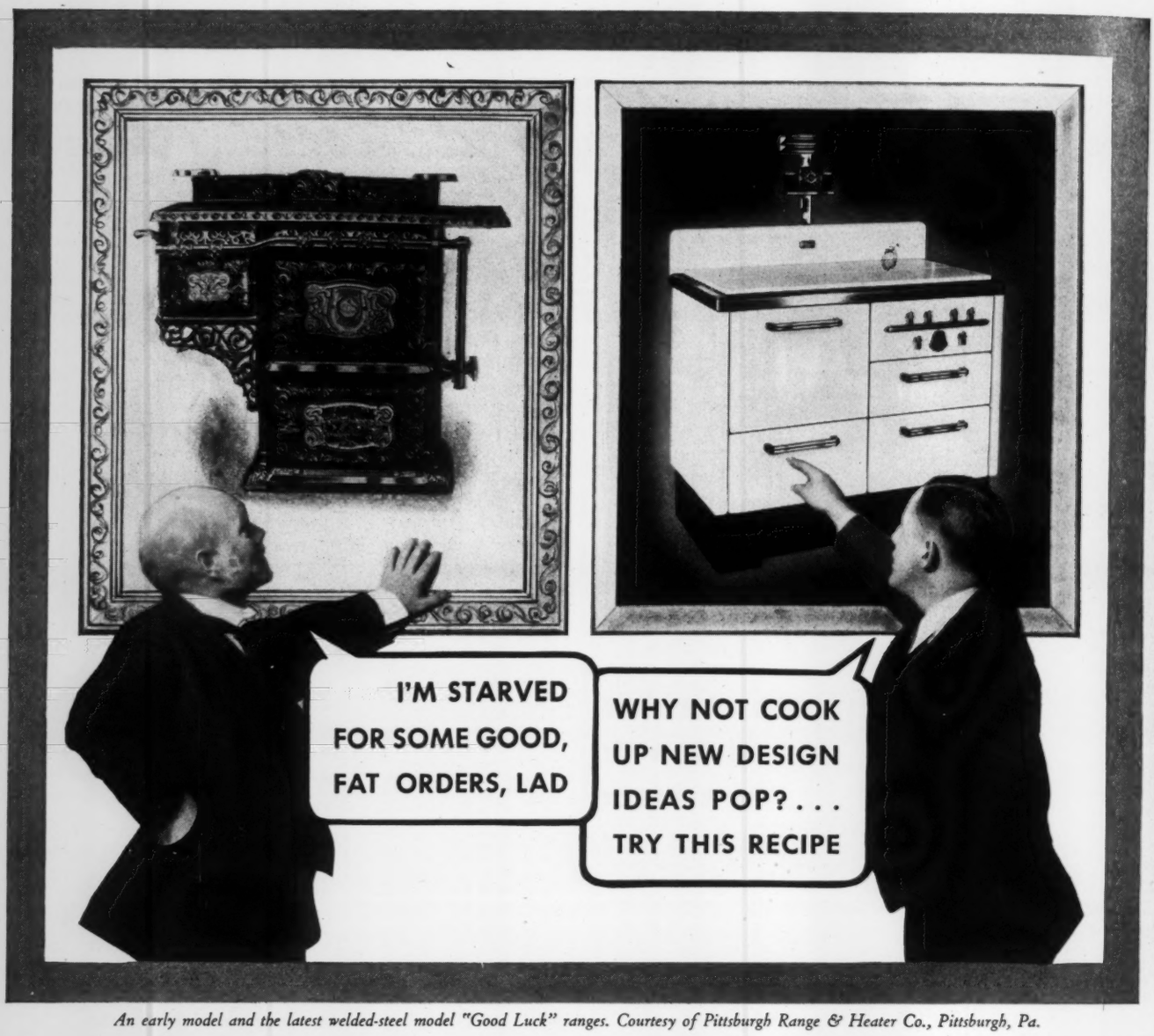
U·S·S CARILLOY ALLOY STEELS
to carry tremendous bearing pressures.

U·S·S HEAT RESISTING STEELS
to endure high temperatures that spell disaster to other metals.

U·S·S STAINLESS STEELS
to resist corrosive environments, to assure long life. Special analyses can be welded with no loss in corrosion resistance.

CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL



An early model and the latest welded-steel model "Good Luck" ranges. Courtesy of Pittsburgh Range & Heater Co., Pittsburgh, Pa.

STREAMLINE FOR SALES WITH WELDED DESIGN

"Here's a proven recipe for fattening business volume:

"**1.** Basic ingredient: One well-seasoned leader of men with a relish for driving costs down and quality up with welding. He's a **P**rofit **C**rusader.

"**2.** Stir up the design department along the lines of welded steel construction.

"**3.** Get the shop hot after ways to produce welded designs at minimum cost.

"**4.** Add the counsel of Lincoln's welding engineers and technicians.

"The result is rich in these profit vitamins: A—Product eye appeal (witness the streamline welded range above). B—Production economy (write Lincoln for examples). C—Speed of delivery (few operations in designing and production). D—Product service economy (through the rigidity, strength and lightness of welded steel). Hundreds are partaking of this dish for a rosy business complexion. Write Lincoln for a bookful of palatable recipes."

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THE LINCOLN ELECTRIC COMPANY

DEPT. C-607 **CLEVELAND, OHIO**

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Variable Speed
BRIGGS & STRATTON
TRANSMISSION

OFFERS EXCLUSIVE FEATURES

Full speed range—in infinite steps from maximum to zero.

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Full torque maintained over entire speed range.

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Speed adjustable stationary or running.

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Accurate speed maintenance—for any given load and setting—unaffected by ambient conditions.

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Straight-line all-metal drive—runs in oil—all parts automatically lubricated. No belts or perishable parts.

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Extreme compactness—no bigger than the motor that drives it.

PROVED BY PERFORMANCE

Every-day dependability has been proved by trouble-free performance in a wide variety of industries. Write for bulletin TP-401 giving prices, dimensions and ratings of units.

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2. Geared Reduction transmission with V belt drive and further reduction by chain to conveyor.
3. Standard type transmission with coupled motor used as main drive on gear shaper.
4. Standard transmission with built-in motor, driving beamer and slasher.
5. Geared Reduction transmission coupled to explosion-proof motor driving gear pump.
6. Geared Reduction transmission with built-in motor and remote control-driving torch-cutting table.
7. Geared Reduction type transmission coupled to motor driving headshaft of conveyor.
8. Geared Step-up transmission for lathe spindle drive with unit completely housed.

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